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ABSTRACT

Based on a simulation of the American economic industrial society, this guide is intended to direct the teaching of mass production in the industrial arts classroom. It is designed so that the 11 units may be lifted out and studied individually or expanded for an interdisciplinary approach. These units cover the following concepts and activities: The history of mass production; the principles of mass production; the process of research and development; business organization and finance; management structure for the classroom; procuring materials for classroom mass production; supporting documents for teaching mass production; mass producing the product; marketing the product; terminal activities; and implementing mass production in the classroom (covers the complete process for several mass production projects, including scaled drawings of products). A glossary of related terms concludes the guide. Although this guide is primarily written for use in industrial education, the authors note that the concept of mass production presented here is compatible with that of other areas such as home economics and business. (BM)

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A GUIDE
FOR
TEACHING CLASSROOM
MASS PRODUCTION

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Without the joint effort of all these individuals and corporations, the task would have been much more difficult and less complete.

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Dear Fellow Educator:

It is with considerable pride that I send this copy of *A Guide for Teaching Classroom Mass Production* for your information. The problems involved in producing such a document are many, and it is with considerable appreciation I commend all of those that made this publication possible.

Arizona has made a rather substantial commitment to career education. We feel that a very strong contribution to career exploration is provided by relating the world of work concepts to students enrolled in Industrial Arts programs. Several avenues are available to meet the challenge of this mandate. We have found many curriculum materials are available, such as IACP and American Industries. Also, we have become keenly aware of a need for additional curriculum materials; thus, this guide was produced. We recognize this guide has some very strong attributes and we concede, there are some weaknesses. It definitely is not the guide. Rather, we feel it is another approach to one avenue of the challenges Industrial Educators face today.

With these throughts in mind, I submit this publication for your review. Should you find it beneficial to your program, please feel free to reproduce any portion of it for your utilization. Limited copies and funds prevent us from supplying out-of-state requests. However, complimentary copies are being made available to State Supervisors of Industrial Arts in all 50 states.

Sincerely yours,

Hoyt R. Kenmore

Hoyt R. Kenmore
Industrial Arts Specialist
Division of Career and Vocational Education

PREFACE

This guide is presented in an attempt to bring more relevance and meaning into the industrial arts classroom. Here is an approach to simulating the real world in the schools by presenting each student with an opportunity to grapple with and solve real problems of our world today. Mass production, as taught in the classroom, simulates our economic society by enabling students to organize an enterprise, develop a product, produce it, market it, and financially benefit from their efforts.

In this guide we are not studying just tools, materials, and processes for industry today is more than that. These things are an integral part of industry, but they must be organized in an efficient manner to optimize their benefit for mankind.

Our lives today are dependent upon many factors we too often take for granted. We depend upon nature for many of the necessities of life, the air we breathe and the water we drink, but in addition man is becoming increasingly dependent upon his fellowman for his life style today. Each modern man contributes to society in accordance with his specialized trade or talent and relies on the specialized trades and talents of others to produce materials he needs. This interaction between contributing members of a society has brought us to the point we are today, both socially and economically. Each person no longer makes his own goods, nor does he perform his own needed services. The efforts of the individual are no longer capable of supplying all that he needs today. An individual could labor twenty-four hours of every day of his life and not produce the quality or quantity of goods that he routinely uses during his lifetime.

Man has learned that through the use of intelligently organized resources, capital, labor, machinery, and raw materials he can provide for all his needs and more. Mass production is the term we use today to describe our efforts to produce goods in the quantity that society demands.

By implementing the teaching of mass production in the classroom, our students will have a better opportunity to grasp the complete concept of our economic industrial society which is so much a part of everyone's daily life. Its value in the classroom lies in the fact that it enables each student to understand and solve the problems of the real world.

Mass Production is an excellent motivational tool in that it contributes vital and realistic experiences to the classrooms and reaches out into the community so that students can easily

grasp and retain the concepts of industry that will become so much a part of their lives. These concepts help the student become aware of just how his society operates so he can function as an intelligent contributing citizen.

The free enterprise system that has made mass production possible is fused in this approach to teaching, so that we are not only teaching the concepts of mass production but demonstrating the basic principles of our economic society as well.

If we in industrial arts education are to adequately interpret industry, we must do more than talk about or describe industry. We need to give the student valid experiences he can take with him when he leaves school. Industry today is mass production and its concepts are the vehicle to develop an understanding of industry.

Through mass production the student will realize how he fits into our technological society and why our country has such a high standard of living. Our students need to develop a realization of and have a willingness to solve the problems of our environment, unemployment, and diminishing natural resources.

Through the use of this guide it is hoped that each student will gain an appreciation for the part he plays in our economic system whether he becomes a machine operator or the president of the company.

The teaching of mass production dovetails with the present emphasis on career education by providing career exploration and preparation experiences for the student. This concept puts the student in charge; he makes the decisions. The teacher then finds his true place as an educator.

Although this guide is primarily written for use in industrial education, the concept of mass production presented here is compatible with that of other areas such as home economics, business and social studies.

Excellent opportunities are available for using this as a part of a core program that would provide experiences in mathematics, English, science, history, art, and geography.

This guide is so designed that any individual unit may be lifted out and fully explored on its own.

Each of the concepts covered in this guide can easily be expanded for an in-depth look at each area through an interdisciplinary approach.

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CHAPTER I

HISTORICAL INTRODUCTION TO MASS PRODUCTION

In using this guide for classroom instruction it is recommended that a historical introduction to mass production be given to the students. This historical introduction does not necessarily have to be presented at the first meeting of the class, but can be presented at any time deemed appropriate.

When man first looked out the door of his cave he saw many of the natural resources we have today, but knew little of their value or how to convert them to meet his needs.

For thousands of years man has spent all his waking hours struggling for the essentials of life. When he developed the idea of making products in great numbers it became evident that the necessities of life could be produced in a shorter time and with improved quality.

Early records of mass production can be traced back to:

- The ancient Greeks and Romans mass producing shoes
- The casting of printing type in the Middle Ages
- The manufacture of dressmaker's pins in 1680, and
- The mass production of plowshares, hammers, and tin plates in 1700.

In 1785 LeBlanc began producing muskets with interchangeable parts in France. Thomas Jefferson brought LeBlanc's idea to the United States where Eli Whitney established his own musket factory in 1800.

The British Navy used mass production for the manufacture of pulley blocks in 1808. Forty-four different machines were specially made for production. With these new machines, ten unskilled men could produce as many pulley blocks as 110 skilled craftsmen. They were producing 130,000 blocks per year with these new techniques. Figure 1-1 graphically shows the increase in output to the decrease in man power.

In 1809 Eli Terry began mass producing wooden clocks and by the end of the 18th century typewriters, bicycles, and many household items were being mass produced in the United States.

Mass production was first used in the automobile industry in 1901 when R. E. Olds produced 4,000 cars.

In 1913 Henry Ford introduced the conveyor system to the manufacture of automobiles and in a few years a car was coming off the assembly line every ten seconds.

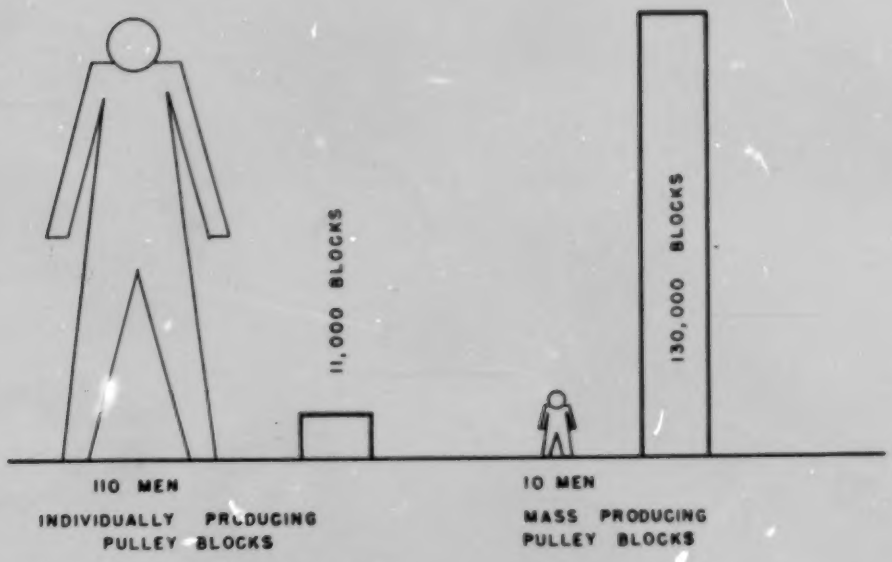

Fig. 1-1 British Navy pulley block manufacturing in 1808.

Oldsmobile Division General Motors Corporation

Fig. 1-2 Interior of the Oldsmobile engine shop at Lansing, Michigan in 1908.

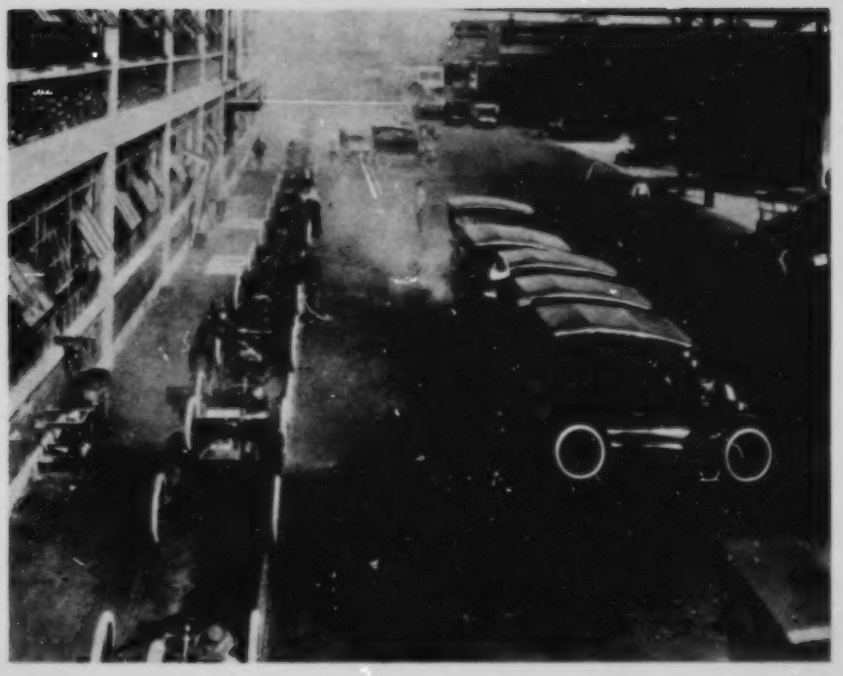

Fig. 1-3 Model T Ford production in 1913.

From the early days of Henry Ford on to today, the mass production process has mushroomed and spread to most all corners of the earth.

In the early 1950's, automation came into the mass production process enabling manufacturing machines to be self-operating.

The concept of cybernetics followed closely behind automation. The self-operating automatic machine led to the need for a self-controlling or self-correcting machine where the machine not only operates itself but also controls itself.

Numerically controlled machines are examples of automated cybernetic mechanisms where the machine acts according to a predetermined program. The machine controls and corrects itself by checking to see if the machine is acting according to the program.

Impact of Mass Production

In the early days of our country the needs of the settler were many and skilled men were few in number to meet these needs. As mass production evolved machines were developed that could be operated by unskilled help and still turn out quality work. Machines were also developed

as muscle extenders which allowed man to concentrate his efforts on the most important phases of his work. Mass production helped overcome the shortages of skilled help and labor and increased man's capacity for production.

From its beginnings to today mass production has provided:

1. An increase in the amount of goods available
2. A higher standard of living
3. A shorter work week
4. Superior quality goods
5. A reduction in the price of goods
6. More work opportunities for more people
7. More efficient use of human and natural resources
8. An easier means of repairing products by replacing parts.

References for Further Study

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Roy T. Bramson, Highlights in the History of American Mass Production (Detroit: Bramson Publishing Company, 1945).

Ford Motor Company, The Evolution of Mass Production, (Dearborn, Michigan: Educational Affairs Department, Ford Motor Company, 1956).

Charles F. Kettering and Allen Orth, American Battle for Abundance (Detroit, Michigan: General Motors Corporation, 1955).

CHAPTER II

PRINCIPLES OF MASS PRODUCTION

As mass production has grown and evolved to the state where it is today, it has become characterized by certain principles no matter what product is being produced. These principles can be demonstrated in the production of simple or complex products being produced by modern mass production techniques.

Interchangeability of Parts

Interchangeability is the property of a part to be randomly selected from any one of like parts and have it accurately fit the product. The ability of a part to be randomly selected depends on the tolerances of measurement used in the manufacture of the original product.

The concept of interchangeability was first used in 1785 by LeBlanc for manufacturing muskets. The first American to use the principle of interchangeable parts was Eli Whitney when he manufactured muskets for the U.S. Government.

The capability of a part to be interchangeable enables automotive mechanics to repair a car by simply replacing the worn part from stock rather than custom making a new part.

As shown in Figure 2-1 interchangeability of parts has economic benefit to customers and repairmen.

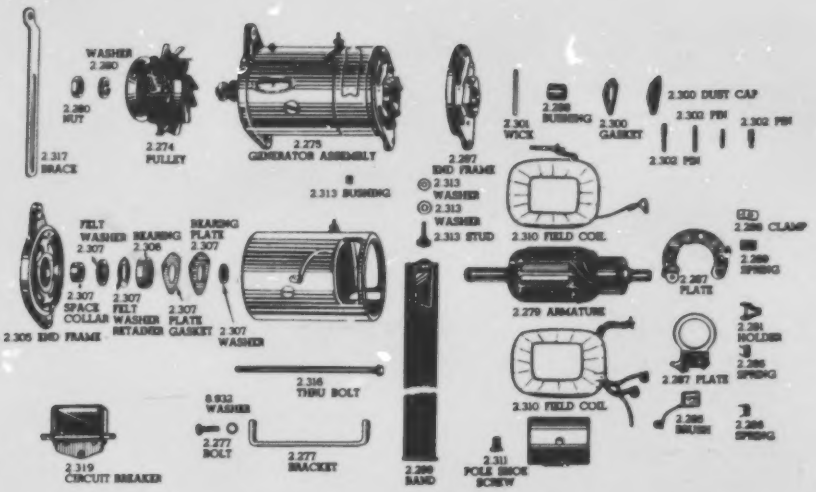
Division of Labor

Division of labor is the separation of work into its elemental tasks, and each task in turn being performed by different individuals.

This concept was first used in the manufacture of dressmakers' pins where each worker had a separate task in making a part of the pin. Elihu Root used the idea of division of labor when he simplified each step of the manufacture of Colt hand guns. The division of labor made for more operations but each individual operation could be done in a shorter period of time.

By dividing the work, the output is multiplied or, in other words, productivity is increased. Specialization also improves the quality of manufactured products.

An example of the division of labor is the automobile assembly line where one man is responsible for performing only one task, such as installing two wheels on the left side of the car,



Chevrolet Motor Division

General Motors Corporation

Fig. 2-1 The generator shown here is ample evidence of the need for interchangeable parts.

in the total assembly of the automobile.

Consideration for the individual is bringing about new developments on the automotive assembly line where a team of several men assemble the entire automobile. This concept helps break the monotony of doing the same repetitive task all day long. This concept has not found application in high volume assembly plants producing 70-100 units per hour.

Assembly Line Methods

1. Tools and materials are placed in their proper sequence of use, thus eliminating waste motion and time.
2. Parts and tools are located at the correct height so that workers can work comfortably without reaching or bending.
3. Assembly lines are designed to provide for spacing of items to compensate for the length of time a particular job takes.

Elimination of Waste Motion

Eliminating waste motion is doing a task in the most efficient manner possible. Frederick Winslow Taylor developed this idea in trying to find the speed at which a worker could most

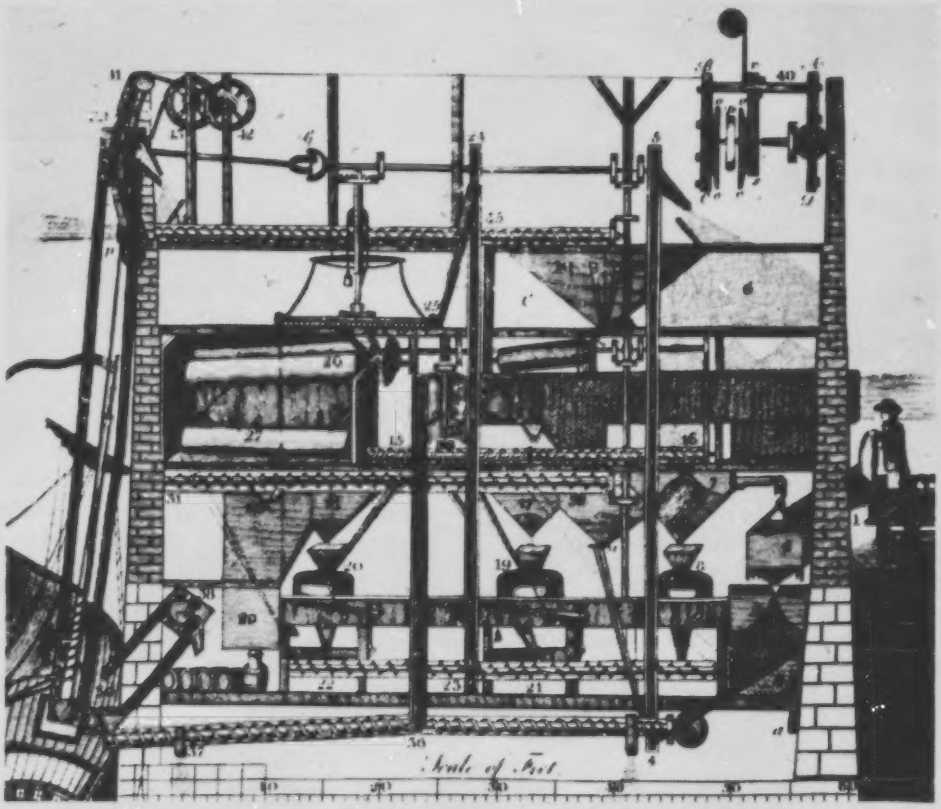
efficiently perform his tasks. Taylor tried to streamline the workers motions so that every move made by the worker was useful.

Time and motion studies are utilized to determine what motions could be eliminated and still maintain production efficiency.

Use of Conveyors

A conveyor is a device which moves objects from one operation to the next. The first conveyor can be traced back to Archimedes' endless screw which was used for lifting water.

Conveyors were first applied to the manufacture of products in 1783 when Oliver Evans built a flour mill where grain moved through the complete milling process without the help of the



(Evans, Young Millwright and Miller's Guide, 1795)

Fig. 2-2 The first complete production line in America.

human hand (see figure 2-2). Oliver Evans used the three basic types of conveyors in use today: endless belt, chain of buckets, and endless screw. "What Makes America Great" is a 16mm film covering Oliver Evans' flour mill. The film is available from the DoAll Company, 245 N. Laurel, Des Plaines, Illinois, 60016.

Additional means of conveying materials include blowers, rollers, liquids, vacuum, and gravity systems.

CHAPTER III

THE PROCESS OF RESEARCH AND DEVELOPMENT

In its truest sense, research attempts to uncover new facts and development is finding the best methods for applying facts. Within the scope of this guide, research and development is presented as a process for thinking through and developing a product from the very beginning.

In the school setting three types of research can easily be carried out by students:

Product research - finding new product ideas to meet the requirements of prospective customers.

Manufacturing research - finding the best methods of making the product.

Market research - finding out whether or not a product will be accepted by the customer.

Research can be divided into a series of activities for the students: ideation, sketching, problem solving, modeling, working drawings, and specifications, prototyping, making a market survey, making a feasibility study, selection, and bill of materials.

Any product starts with an idea. Even though there are very few truly new ideas today, the different possible combinations of existing ideas are almost limitless. New processes and techniques also multiply opportunities for applying old ideas.

Ideation

Ideation is the process of coming up with new thoughts. These thoughts or ideas can be generated or brought about in many ways. Below are listed several established methods for coming up with ideas:

1. Brainstorming. Brainstorming is a free-wheeling group discussion to generate ideas. Brainstorming usually follows this procedure:

   - State the problem in its simplest form.
   - Don't criticize or judge any idea.
   - Accept any kind of idea.
   - Encourage all ideas.
   - When all ideas have been presented, evaluate and expand these ideas for implementation.

   Brainstorming can be done on an individual basis as well as in a group.

2. Catalog Technique. Simply looking at catalogs and printed material to get ideas that will help foster other ideas.
3. Attribute listing. To improve existing products
   a. Choose the object to improve.
   b. List the parts of the object.
   c. List the essential basic qualities, features, or attributes of the object and its parts.
   d. Change or modify each attribute to better satisfy the original purpose of the object or to help it fulfill a new need.

The whole process of ideation in the school setting is to give the students an opportunity to think in a creative manner. A class may combine or use all of these techniques in the ideation process.

Sketching

Students will find that sketching is a valuable technique for developing their preliminary ideas. Sketching is simply the process of drawing without the aid of drafting instruments. Sketches should include dimensions and other details necessary to produce the product.

Sketches enhance any written descriptions or products the student may consider developing. When an idea is sketched and preserved on paper, the thought can be available and saved for future use. Without a sketch the full meaning of an idea can escape and be lost even though it may be written down.

Problem Solving

Once an idea has been generated and recorded on paper, it must be developed into a useful product. Each aspect of the problem or product must be solved in order to make the product salable and suitable for school production.

The following is a logical sequence used to solve these problems:

1. Define the problem - be clear and specific and agree on what the real problem is. List all potential problems.
2. Gather information - obtain and discuss information about the problem.
3. Determine the cause of the problem - find out why the problem exists.
4. Think of solutions - use ideation techniques.

5. Evaluate the solutions - which ones are best.
6. Choose a solution - decide on one or more alternatives. Verify the quickest, easiest, and most economical solution.
7. Plan how you will make the solution work.
8. Put the solution into practice.
9. Follow up - solutions to one problem may produce new problems in other areas.

Modeling

Once the major development problems have been solved, the students may make a model of the product. The model is the first three-dimensional representation of the product that embodies all of the ideas contained in the two-dimensional sketch. The sketch comes to life.

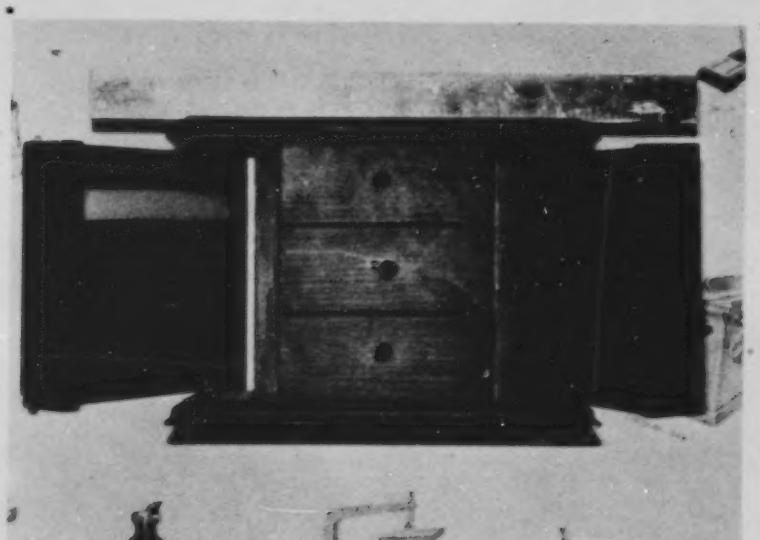


Fig. 3-1 Model of sewing chest Isaac Imes School Glendale, Arizona.

Working Drawings and Specifications

The working drawings and specifications are optional in that the manufacture of the product can continue without these items because they are essentially incorporated into the preliminary sketches, the model, and the prototype.

However, a complete set of working drawings and specifications (detailed descriptions of the

parts, and statements of size, quality, and performance) for the product selected are strongly recommended.

These drawings and specifications provide the student with an insight into all the complexities of the product and with the communicative skills necessary to convey a technical idea to someone else. They also are valuable in that the student gains a fuller understanding of industrial practices.

Prototyping

A prototype is the first finished product which is produced after the model has been made. During the time the first product is being built, many initial problems can be solved, and the methods of production can be determined along with the sequence of operations to be performed.

CAUTION

The prototype should not be by-passed in attempting to save time. This is one of the most crucial steps in the successful completion of a mass production activity. If the prototype is not built, you could arrive at the assembly stage and find that the parts do not fit together. The prototype also helps point out any need for production design changes.

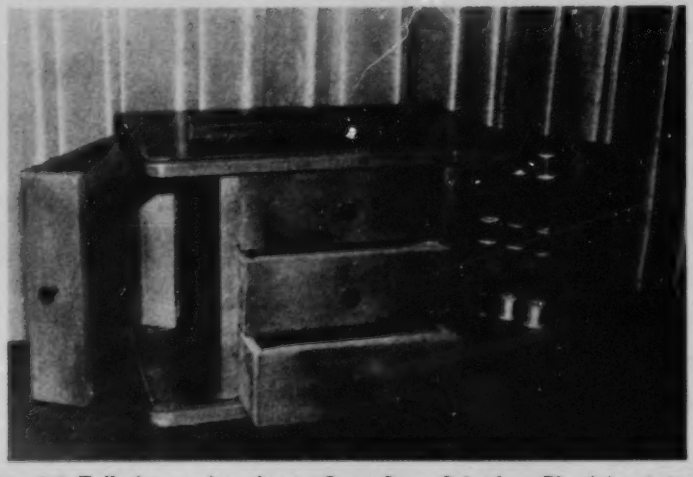


Fig. 3-2 Full size sewing chest Isaac Imes School Glendale, Arizona.

Building prototypes can provide individual instruction and work where every student can build his own prototype or where teams of students can build different prototypes of various products. In addition, the whole class could work on one prototype. Often a team approach to working on a problem can bring numerous insights and unique ideas.

These initial stages of research and development can provide each student with an opportunity to individually express himself. The element of individual creativity is fostered through thinking of an idea and developing it into a tangible product.

Making a Market Survey

Once the prototype has been created, it is necessary to find out if there is a market for the product or if a market can be developed. For if there is no market, production of the product is useless.

A market survey finds out whether or not individuals or other companies will buy the product. The survey can be taken using drawings and sketches, using the model, or using the prototype.

The market survey can be used to find out such information as:

1. Does the product appeal to the customer.
2. How much the consumer is willing to pay.
3. Should there be any modifications to the product.
4. How useful is the product.
5. How many items can be sold.
6. Is the product one that you can sell without first educating the public to its usefulness.

The market survey can be made for several products or for just one selected product.

If the market survey shows the product won't sell, then the product should be modified or discarded. If the survey shows the product will sell, then a feasibility study must be made. A market survey form for school use is shown in figure 3-3.

Making a Feasibility Study

A feasibility study is a concentrated examination of the product to see if it can be produced with existing equipment, facilities, and student abilities.

A feasibility study asks the following questions:

- Can we get the required materials?

MARKET SURVEY

Product Name _____

1. Male Female
2. (a) Age: Under 10 ☐; 10-11 ☐; 12-13 ☐; 14-15 ☐; 16-17 ☐;
   18 years and up ☐
   (b) Do you know what this product is? _____
3. Would you use this product? _____
4. Do you have one of these products now? _____
5. Would you buy more than one of these products? _____
6. How much would you pay for this product?

0 to 25¢ ☐	1.01 to 1.50 ☐	4.00 to 5.00 ☐
26 to 50¢ ☐	1.51 to 2.00 ☐	5.00 to 6.00 ☐
51 to 75¢ ☐	2.01 to 3.00 ☐	
76 to 1.00 ☐	3.00 to 4.00 ☐	

7. Is there anything you don't like about the product? _____
   If yes, how would you change it? _____
8. Would you give this product as a gift? _____
9. How well does this product serve its intended purpose?
   Not at all ☐ Poor ☐ Good ☐ Excellent ☐

Fig. 3-3 Market Survey Form

- Can we get the necessary equipment?
- Can we get the capital?
- Do we have enough time?
- Can workers be trained to do the jobs?
- Do we have enough people to do the work?
- Would the purchase of some manufactured parts be more economical?
- Can some of the work be subcontracted to other students?

Suggestion: The concept of subcontracting would be especially useful if the class were organized into more than one manufacturing activity. If one group finishes early, it could serve as

a subcontractor to the other manufacturing enterprises.

Once all of the preceding preliminary work has been completed, agreement must be reached as to what product to produce.

Product Selection

Before the product is selected, the market survey and feasibility study must be carefully analyzed. These two studies will help determine which product will fit the limitations of the school laboratory, the students, and the instructor, but still yield a marketable product that has interest for the student and involves the desired learning activities.

Bill of Materials

Once the product has been selected and drawings made, the amount of material needed to produce the product should be determined.

The bill of materials provides a written description of the necessary materials.

The bill of materials should include the following information:

- The name of the part(s).
- The number of pieces of material for each part.
- The size of the pieces needed.
- Description of the material.
- The cost per unit of the material.
- The total cost of the part.
- The total cost for the product.

See Chapter 10 for sample bill of materials.

CHAPTER IV

BUSINESS ORGANIZATION AND FINANCE

This section is intended to guide the teacher in helping students organize their business and financial structure. The normal mass production activities can be extended to include these concepts.

Types of Business Organizations

Individuals, groups, or the whole class can establish for itself one of the following business structures:

1. Proprietorship - a business owned by one person. The owner has complete control over the operation of the business. The owner is responsible for raising his own capital, all profits belong to the owner, and all losses become his responsibility. If the business fails, the owner's personal property can be held for payment of debts.
2. Partnership - a business owned by two or more persons. Partners have full rights to all the profits. Each partner has unlimited liability for the debts of the firm. If the partnership fails, the personal property of the partners can be held for payment of debts. With a partnership there is a great need for the partners to get along with each other. If one of the partners should die the partnership no longer exists.
3. Corporation - a business owned by many people who invest their money in an enterprise and share in the profits of the business. Each person that puts money into the corporation receives a stock certificate for his money. The corporation is usually run by people hired by the stockholders. A corporation is essentially an artificial person that can do business. The people that put their money into the corporation are not liable for the corporation's debts beyond the amount they invested. A corporation usually has a board of directors elected by the stockholders.

   A corporate structure in the classroom stimulates interest and provides the greatest opportunity for a total look at mass production. For purposes of classroom organization the teacher can act as the board of directors. From this point a president and other officers are elected.

   The general procedure for forming a corporation in the State of Arizona is shown in figure

4-1. After the requirements have been met a Certificate of Incorporation is issued (figure 4-2).

A sample Articles of Incorporation for use in the classroom is shown in figure 4-3.

Methods of Obtaining Capital

If the owner of a business does not have his own money to invest in a company he must obtain it from an outside source. The three most common methods for obtaining capital are:

1. Loan - a loan is money borrowed from people or other companies. Usually a certain amount is charged for the use of the money. The big advantage of a loan is that it allows the owner of a business to maintain control over the business. One disadvantage is that it starts the business out with a fixed obligation that must be met.
2. Credit - credit is borrowing on future hopes of production. Usually material goods are sold to a company to be paid for at a later date. The advantage of credit is that cash money is not needed to start a business. A disadvantage lies in the fact that the cost of the material goods must be paid off with interest or a service charge.
3. Stocks - a stock certificate represents an investment of money into a company for an expected share of the profits. Stocks enable a business to get money from many sources which makes it possible to organize on a larger scale. Stocks have their disadvantages in that a certain portion of the company's profit must be continually paid to the stockholders. In addition, the stockholders have control of the business.

Financing Classroom Production

One of the simplest ways to finance classroom production is for the students to obtain credit from the teacher for materials. After the products have been sold then the teacher is paid for the materials.

If local merchants are willing, a similar agreement could be reached with them; if this is possible, it is a more realistic approach.

Another method for obtaining capital in the classroom is to sell shares of the company to students. This could be restricted to one class or open to the entire school. Stock certificates can be issued for a predetermined amount, allowing everyone to participate.

A sample stock certificate is shown in figure 4-4.

REQUIREMENTS FOR INCORPORATING DOMESTIC CORPORATION
A.R.S. CHAPTER 10-101 - 909

1. CHECK NAME FOR AVAILABILITY.

2. ADOPT ARTICLES OF INCORPORATION.

CONTENTS OF ARTICLES:

1. Name of Corporation.
2. Principal place of business.
3. Nature of business.
4. Commencement and termination of corporate existence, (25 years).
5. Board of Directors, and Officers who will conduct corporation.
6. Annual meeting date.
7. Capitalization (Profit corporation only).
8. Indebtedness (cannot exceed 2/3 of capital stock).
9. Exemption of Stockholders.
10. Statutory Agent and Address(State resident for 3 years.
11. Incorporators, residence and mailing address.
12. Signatures of Incorporators, notarized.
13. NON-PROFIT ONLY -in addition to requirement stated above must set forth the holding of election of directors and the time and place where it was held - Section 10-452.

Number of Copies - Original and two (2) conformed copies.

1. Original copy for filing for Arizona Corporation Commission.
2. Copy to be certified for recording.
3. Cppy for publication.

PUBLICATION OF ARTICLES - must be published 6 consecutive times in a newspaper published in the county in which the principal place of business is located in Arizona.

3. INCORPORATING FEES:

Profit - $42.00
Non-Profit - $27.00

4. FISCAL DATE : Letter adopting fiscal date is to be submitted for annual report purposes.

ARIZONA CORPORATION COMMISSION
Incorporating Division
1688 West Adams
Phoenix, Arizona 85007

Fig. 4-1 Incorporation Procedures

STATE OF ARIZONA

Corporation Commission

To all to Whom these Presents shall Come, Greeting:

BE IT KNOWN THAT

HAVING SUBMITTED TO THE ARIZONA CORPORATION COMMISSION EVIDENCE OF COMPLIANCE WITH THE LAWS OF THE STATE OF ARIZONA GOVERNING THE INCORPORATION OF COMPANIES, IS, BY VIRTUE OF THE POWER VESTED IN THE COMMISSION UNDER THE CONSTITUTION AND THE LAWS OF THE STATE OF ARIZONA, HEREBY GRANTED THIS

CERTIFICATE OF INCORPORATION

AUTHORIZING SAID COMPANY TO EXERCISE THE FUNCTIONS OF A CORPORATION, UNDER THE LAWS NOW IN EFFECT IN THE STATE OF ARIZONA, AND SUBJECT TO SUCH LAWS AS MAY HEREAFTER BE ENACTED, FOR A PERIOD OF TWENTY-FIVE YEARS FROM THE DATE HEREOF, UNLESS SOONER REVOKED BY AUTHORITY OF LAW.

BY ORDER OF THE ARIZONA CORPORATION COMMISSION

In Witness Whereof, I,
THE CHAIRMAN, HAVE HEREUNTO SET MY HAND AND CAUSED THE OFFICIAL SEAL OF THE ARIZONA CORPORATION COMMISSION TO BE AFFIXED AT THE CAPITOL, IN THE CITY OF PHOENIX, THIS
DAY OF A. D.

CHAIRMAN

ATTEST

SECRETARY. NO.

BY

ASSISTANT SECRETARY.

Fig. 4-2 Certificate of Incorporation

ARTICLES OF INCORPORATION

Article 1. The name of the corporation shall be _____
_____.

Article 2. The place of business is _____
_____.

Article 3. The nature of the business is _____
_____.

Article 4. The corporation shall begin on _____
and end on _____.

Article 5. The board of directors shall be _____
_____
_____.

Article 6. The officers shall be _____
_____ _____
_____ _____

Article 7. The address of the corporation is _____
_____.

Executed this _____ day of _____ 19___.

_____ _____

Fig. 4-3 Articles of Incorporation

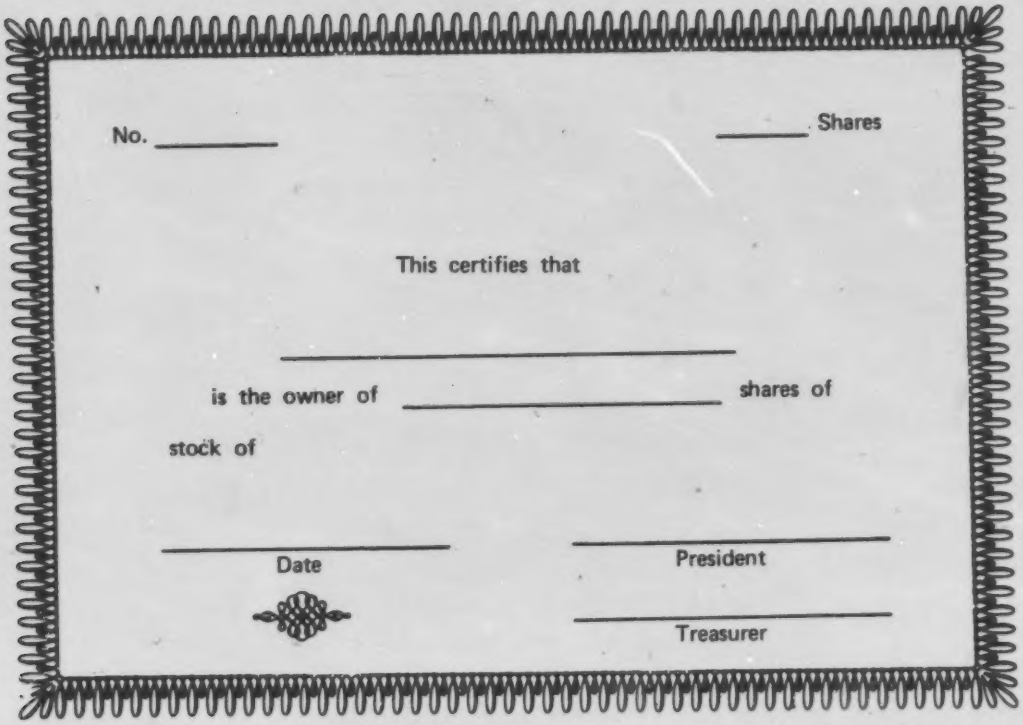


Fig. 4-4 Classroom Stock Certificate

CHAPTER V

MANAGEMENT STRUCTURE FOR THE CLASSROOM

In a mass production operation many people are needed to produce a product. But, only when these people are properly placed and utilized can an efficient system be achieved. The job of management is to direct and coordinate the efforts of these people in order to produce the product.

In establishing a management structure detailed attention should be given to defining the duties and responsibilities of each position which is essential to the establishment of a smooth working enterprise. A smooth functioning management organization simplifies classroom control, helps insure success, and eliminates confusion and wasted time. In a management structure the teacher would normally serve as the board of directors.

Management Positions

A typical classroom management structure (Line and Staff Organization) would include the following positions:

President. Provides guidance, direction, and control for the entire organization through other management personnel. In a corporation the president is responsible to the chairman of the board of directors. He is responsible for a flow of communication between all departments to efficiently carry out the corporation's policies and objectives.

Vice President - Production. Directs the making of the product by controlling processes, the flow of materials, and quality of the product.

Vice President - Procurement. Orders, obtains, and controls all equipment, materials, and supplies.

Vice President - Personnel. Employs and trains workers so that the task and the person will be equally matched, providing smooth efficient operation.

Vice President - Sales. Researches the market, promotes, advertises and sells the product.

Vice President - Finance. Obtains, controls, disburses, and records money in the production of the product.

The above list of personnel is not meant to be a confining structure but a point of departure.

So that each management structure might adequately serve each individual enterprise, additional management positions may be added as deemed necessary.

Methods of choosing personnel:

Teacher selection: With this method the instructor appoints students to the various positions. These appointments may be permanent or on a rotating basis so that all students may gain experience in the various positions of responsibility.

Student selection:

- Election: students may hold an election to fill positions of responsibility within the enterprise.
- Application: role playing may be used in setting up an employment office and having each applicant fill out an employment application. Final selection of employees may be made either by one student or class vote.

Typical organizational structures:

Line organization: As the name implies the positions listed on the organizational chart are in a vertical line. With this type of organizational structure the president handles all the problems. He has no one to help him with production, procurement, sales, advertising, finance, or personnel. This type of organization is typical of a small company.

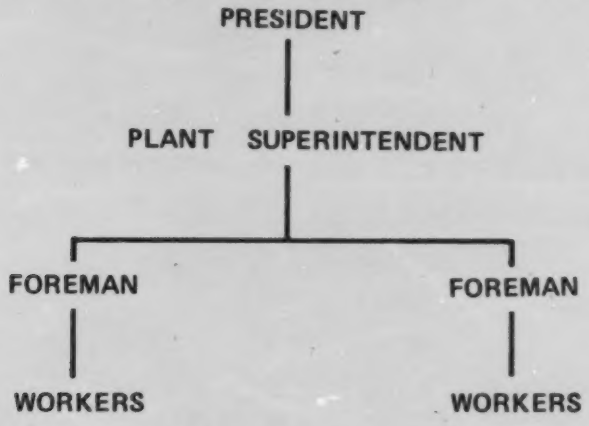


Fig. 5-1 Line Organizational Chart

Line and staff organization: This type of organization is the same as above except special people are added to help the president. These people still report to the president who maintains overall control of the enterprise. In larger companies it is impossible for one person to control all the different phases of an enterprise. Depending upon the

complexity of the enterprise, these duties can be further subdivided.

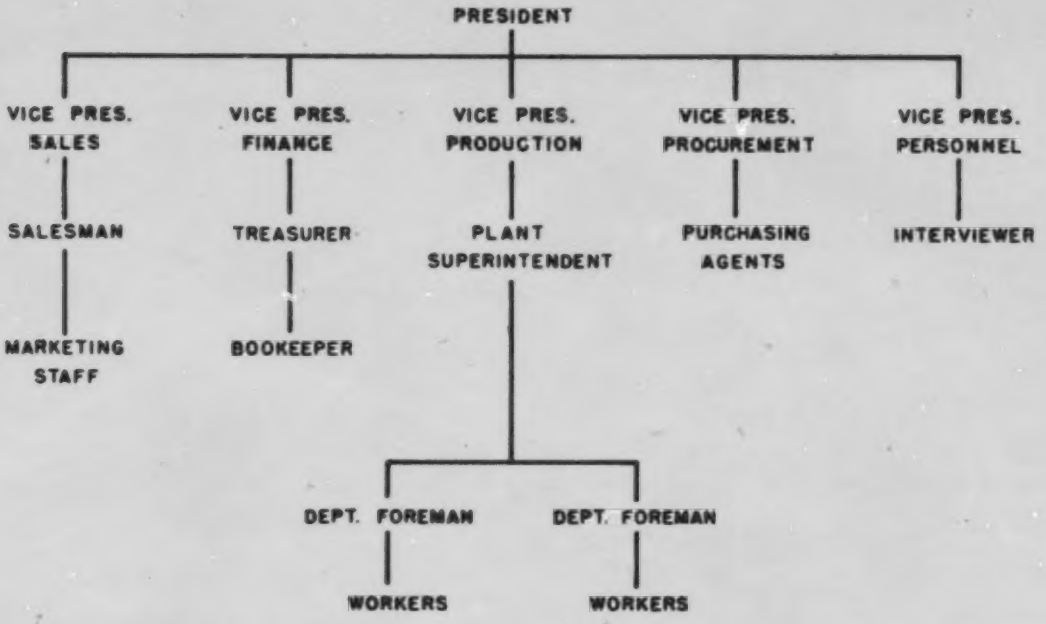


Fig. 5-2 Line and Staff Organizational Chart

CHAPTER VI

PROCURING MATERIALS FOR CLASSROOM MASS PRODUCTION

Procurement is obtaining or securing the necessary materials and equipment for production.

Materials

1. The cost of materials may be determined by:
   a. Estimate - an estimate is a given price that is subject to change. Estimates can be given for a portion of or the whole job.
   b. Quotation - a price quote or quotation is a statement of the current price for work or materials. A quote is not given on a competitive basis.
   c. Bid - a bid is a definite fixed price given on work or material as a complete job. A bid is usually given by several competing firms so that the best bid may be selected.
2. Materials may be obtained through:
   a. Local sources.
      (1) New materials
         (a) Building and supply companies
         (b) Lumber and hardware stores
         (c) Steel distributors
         (d) Discount houses
         (e) Contractors
      (2) Used materials
         (a) Scrap yards
         (b) Contractors
         (c) Salvage companies
   b. State and national sources
      (1) Mail order houses
      (2) Federal surplus property
3. Quality of materials.

   The quality of an item is the degree to which an item effectively serves its intended purpose. When selecting materials, quality must be taken into consideration. If the

quality of the material is too low, the material may not produce a suitable product. If the quality is too high, the product may be too expensive to market. In industry "value analysis" is used to ensure that the consumer gets value for his dollar, but also that the company producing the article does it at minimum cost to them. A compromise must be obtained to produce a product of good quality at a marketable price.

4. Quantity of materials.

   The quantity of material is the amount required to make the product. If too little is obtained, you may have to stop production and wait for more materials. In addition, specific materials may no longer be available after time has passed. If too great a quantity is obtained much of the material will be left over after production.

5. Price - the price is the amount of money asked for an item. Prices of materials from different sources should be compared. The objective is to get the lowest price on materials, but quality must not be ignored.

6. Timing - timing is having something when it is needed. All materials should be purchased far enough in advance so that the materials are available when they are needed. If the materials are received late, this will stop production. If materials are received too early, there may not be any place to temporarily store them.

Equipment for Production:

When planning a product, the availability of equipment must be considered along with the capacity of the equipment in relation to the product to be manufactured. If pieces of special equipment are not at the school, they may be borrowed or rented from outside sources. In manufacturing a product, the cost of equipment must be taken into account. Therefore, to realistically simulate a production operation, the cost for the use of equipment should be included in the cost of the product.

CHAPTER VII

SUPPORTING DOCUMENTS FOR TEACHING MASS PRODUCTION

In the mass production of a product all activities should be plan recorded so that the students can easily visualize the proposed events and progress happening.

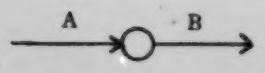
PERT

One of the most helpful tools of management today is the PERT diagram. PERT provides a comprehensive overview of all the activities taking place. The PERT diagram may be used by each class to plan their entire mass production operation.

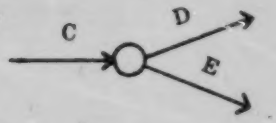
Program Evaluation and Review Technique (PERT) is a method of solving problems. PERT is a systematic method of laying out and planning any task, checking to see if the various operations are in a logical order, and keeping track of the progress.

PERT makes use of an arrow diagram to plan an operation. Each individual activity is represented by an arrow. (The length of the arrows is insignificant.) The arrow network starts from the beginning with the arrows connected to show the logical flow of work.

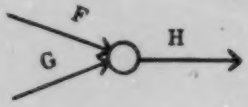
Examples of arrow relationships:



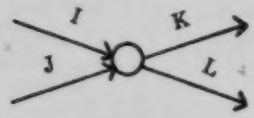
Job B cannot start until job A is completed.



C must be completed before either D or E can start.



H cannot start until both F and G are completed.



Both I and J must be finished before either K or L can start.

For a detailed analysis of PERT see Planning and Control With PERT/CPM by Richard I. Levin and Charles A. Kirkpatrick.

The following illustration shows how a PERT diagram can be used to plan the construction of a house.

- List all the activities that must be performed.

prepare site	heat and A/C
plumbing	sheet rock
concrete	trim
framing	paint
wiring	floor covering
windows and doors	landscape
roofing	fixtures
exterior siding	insulation

- Analyze the activities. Each of the activities must be analyzed in terms of the following questions:

1. What other activities must be completed before this activity can start?
2. What other activities can be done during this activity?
3. What activities cannot start until after this activity is finished?

- Draw the arrow diagram.

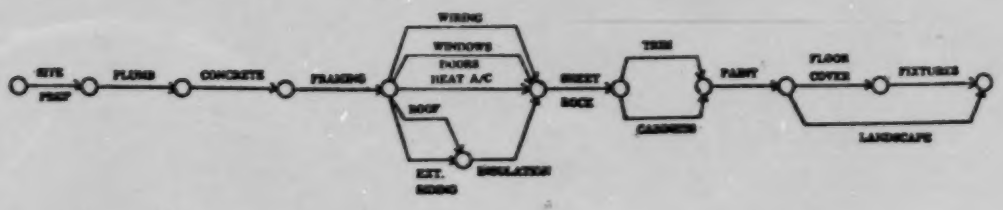


Fig. 7-1

The arrow diagram provides a logical plan for constructing the house.

● Estimate the time for each activity.

Activity	days	Activity	days
prepare site	1	heat and A/C	3
plumbing	2	sheet rock	2
concrete	1	cabinets	1
framing	4	trim	2
wiring	2	paint	2
windows & doors	1	floor covering	1
roofing	3	landscape	3
exterior siding	2	fixtures	1
insulation	1		

● Insert times and analyze network.

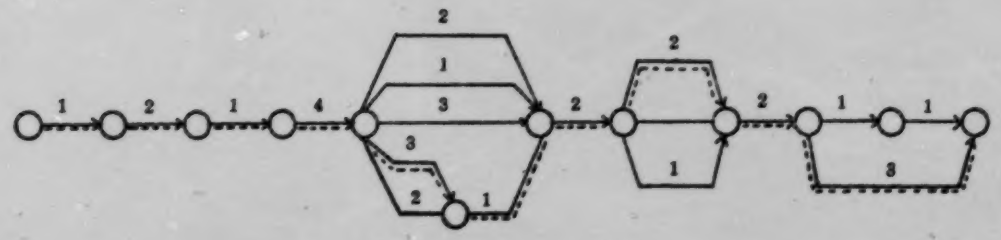


Fig. 7-2

Now we can analyze the network and find the minimum time it takes to build the house. The minimum time to build the house is the longest time sequence from start to finish and is called the critical path. In the above PERT diagram the dashed line shows the critical path for building the house which is 21 days.

The spare time available for activities on other than the critical path sequence throughout the

network is known as float. Float helps in determining priorities between activities, the smaller the float the greater the priority.

As an example, two days of float or spare time is available for wiring the house; therefore, the wiring may be started as much as two days after the start of the roofing and still have the wiring finished on time.

In summary, there are five steps in the use of PERT for mass production:

1. Prepare an activity list
2. Analyze the activities.
3. Draw the arrow diagram.
4. Estimate the time for each activity.
5. Analyze the network.

Once the PERT chart has been made, additional charts can be developed to fully plan the entire mass production operation before it starts. Thorough planning keeps the students informed and helps the teacher have a smooth running class.

A PERT diagram used in classroom mass production is shown in Chapter X.

Progress Chart

A progress chart shows the day-by-day activities of mass production. The progress chart can also be used to record the proposed as well as the actual number of man hours worked per day. A sample progress chart is shown in figure 7-3.

Progress Report

The progress report is used to record the work up to a certain time. A progress report can be used on a daily or weekly basis depending upon the length of the production period. The progress report is very useful in determining the status of each activity, which, in turn, will show areas where additional work needs to be done. A sample progress report is shown in figure 7-4.

Both the progress chart and the progress report use the list of activities set up for the PERT chart.

Flow Diagram

The flow diagram shows a view of the space where the mass production activity takes place and the location of work areas, machines, or benches, with a connecting series of arrows and lines

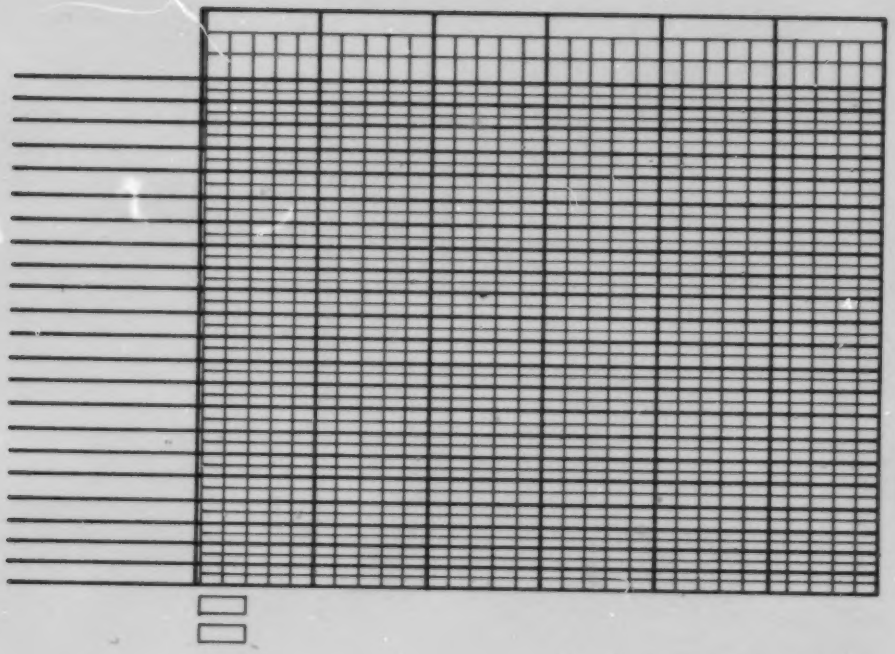


Fig. 7-3 Progress Chart

PROGRESS REPORT

ACTIVITY NUMBER AND DESCRIPTION	ESTIMATED TIME MAN HOURS	PERCENT COMPLETED 25%	50%	75%	100%	MAN HOURS THIS WEEK	CUM. MAN HOURS

Fig. 7-4 Progress Report

to indicate the path taken by the product. Figure 7-5 shows a sample flow diagram.

An additional flow chart is included in Chapter X.

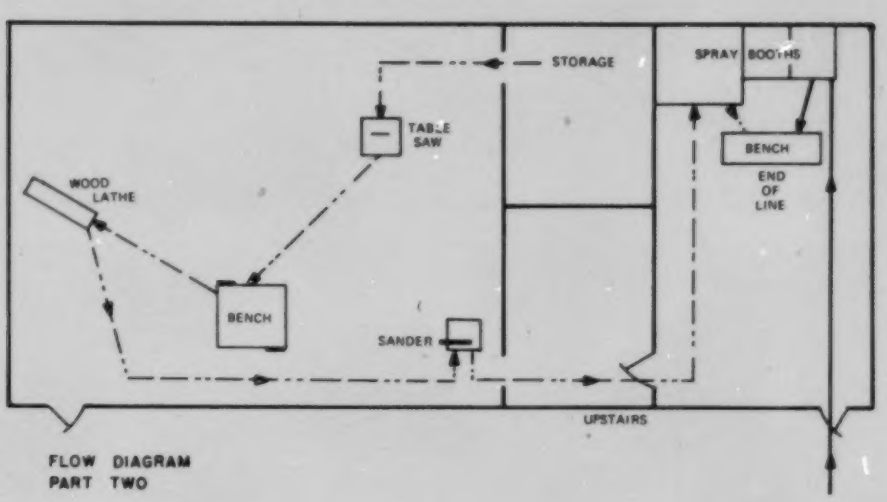


Fig. 7-5 Flow Diagram

Operation sheet

Operation sheets are used to show the processes necessary to complete each component part of the product. Every step in the operation is written down and the tools necessary for each step are specified. The operation sheet is very useful in planning the tools, materials, and time necessary to produce each part.

A sample operation sheet is shown in figure 7-6.

Job Description

A job description consists of a brief summary of the job, a list of the tasks involved in the job and the qualifications a worker must have to do the job.

The job description enables each worker to know exactly what the job is before he does it and enables the personnel director to adequately place workers. A sample job description is shown in figure 7-7.

Cost Statement

Cost statements are necessary to show where and how money is spent in the production of a product. This statement can help determine the amount of capital needed, what the selling price should be, and how to eliminate waste. A cost statement for classroom use is shown in figure 7-8.

OPERATION SHEET

PART NAME: DWG. NO. QUANTITY:

MATERIAL: SIZE: WT:

NOTES:

OPER. NO.	SPECIAL TOOL NO	MANUFACTURING OPERATION OR OPERATION DESCRIPTION

INSPECTION INSTRUCTIONS:

Fig. 7-6 Operation Sheet

Profit and Loss Statement

The purpose of a profit and loss statement is to show how much money was made or lost during the period of operation. It is essentially a summary of the income and expenses of a company. A sample profit and loss statement is shown in figure 7-9.

Daily Log

A daily record of events or a log may be kept so that a day-by-day account of the mass production can be kept for future reference.

THE SUPERIOR LIGHTING COMPANY

JOB DESCRIPTION

Job Title: Finisher Department: Painting

SUMMARY OF JOB

The finisher applies various coatings to the product. He must be able to operate finishing equipment and work to specifications.

DUTIES

1. Applies paint to product using spray gun.
2. Mixes and thins paint for spraying.
3. Stores products for drying.
4. Does touch-up work on damaged finishes.
5. Is able to clean finishing equipment.

WORKER SPECIFICATIONS

Prior training is required to become familiar with equipment and finishes. Must not be allergic to coatings.

Fig. 7-7

PRODUCTION

COST STATEMENT

Direct Costs	
Materials	15.00
Labor	
Indirect Costs (Overhead)	
Machines	2.00
Work spoilage	1.00
Advertising	2.50
Cost of Production	20.50

Fig. 7-8

THE DOUGH COMPANY

PROFIT AND LOSS STATEMENT

Sales	35.00	
Less cost of goods sold	20.00	
Gross margin		15.00
Expenses of Operation		
Advertising	1.50	
Rent		
Repairs	.75	
Taxes		
Less total operating expenses		2.25
Operating Income		12.75

Fig. 7-9

CHAPTER VIII

MASS PRODUCING THE PRODUCT

Pilot Run

After all initial work has been done in setting up the production line, a practice or trial run must be made to see if the system is functioning correctly. Problems that occur during the pilot run can be worked out before actual production begins. Activities that precede the pilot run are:

Operator Training. At this point the individual person must be trained to handle a specific job at a work station.

- Specialization - Each job at a work station is specialized (that is, it is not like the other jobs in the production line). In training the operator he must be given the specific specialized information about that job so he may perform it efficiently.
- Safety Program - When training individual operators or workers safety must be stressed. For if an accident occurs, not only is the worker injured but production stops. Standard safety precautions should be observed for the different types of activities performed. The instructor should become familiar with the Occupational Safety and Health Administration plan as adopted by the State of Arizona.

Arrangement of Equipment - The arrangement of equipment is necessary for a smooth flow in production. This task should initially be planned in the flow diagram, but during and after the pilot run changes may be necessary.

In some laboratories it may be impossible to rearrange machines due to their being permanently attached to the floor.

Tooling Up - Tooling up is getting all the pieces of equipment ready to produce a specific item. The tooling up process includes the making of the necessary equipment to position, hold, and guide tools and material to make a product.

- Jigs - A jig is a work-supporting, work-holding, and tool-guiding device that can be moved with the work.
- Fixture - A fixture is a work-supporting and work-holding device usually attached to a machine.

The jigs and fixtures used in school labs may be of simple design and construction for these activities. A sample welding fixture may be found in Chapter X.

The tooling up process usually takes the longest time of the various set-up operations, but once it is completed a thousand identical parts can be made as easily as one.

Materials Handling - Materials handling is the art and science of moving, packaging and storing of objects in any form. Material handling may be accomplished by any of the following methods:

Air transport

Pneumatic tubes

Containers

Pallets

Skids

Conveyors

Belts

Bucket

Screw

Vibrating

Cranes

Elevators

Industrial vehicles

Fork lift

Industrial tractors

Hand trucks

Straddle trucks

Many materials handling devices can easily be made in the classroom such as gravity chutes, simple conveyor belts, and small pallets.

Quality Control - Quality control is the process of measuring and testing products to see that established standards are being met. These standards are set for purchased materials, processing procedures and finished products. Quality control is an on-going process during the production. It is needed for parts to be interchangeable, to prevent production of faulty parts and to assure the successful production of the product.

One of the most common quality control devices is the gauge. A gauge is used to determine whether a part is within specified limits.

Fig. 8-1 Courtesy Pratt & Whitney

Each of the gauges shown in figure 8-1 is made with a go and a no-go designation. The designation "go" means the gauge must slide on or into the work. The "go" gauge designates the minimum allowable dimension. The designation "no-go" means that the gauge must not slide on or into the work in order for the work to be acceptable. The "no-go" gauge designates the maximum allowable dimensions.

The pilot run should begin after all preparations have been accomplished and prior to a production run so that a check of all setups can be made and necessary corrective action taken.

Production Run

Once the pilot run has been made and necessary corrective measures taken the production run should begin. During the production run many problems can be avoided by careful planning in the following areas:

On-the-Job-Training (OJT) - On-the-job-training is used to instruct new or transferred employees on the production line. This method is used instead of a classroom because the jobs are usually too varied for group instruction. Following are the steps for on-the-job training:

- Break down the job into sequential steps. An operation sheet is needed for each job

taught. Along with the operation sheet should be information about quality, safety and housekeeping.

- Prepare the work station. The work station should be prearranged for the trainee.
- Instruct the trainee. Most people use the method "tell him, show him, and let him show you." This is usually insufficient. There must be a plan setting down in detail the information and the procedures the trainee is expected to know. One plan of instruction would be:

  (1) Prepare the worker - put him at ease about the job.

  (2) Present the operation - work from the operations sheet in a step by step manner.

  (3) Have the worker perform according to the step by step procedure.

  (4) Follow-up instructions should be given as well as checks to see if all is going well.

Preventive Maintenance - Preventive maintenance is a program of upkeep that anticipates failure of equipment.

Successful preventive maintenance depends in a large degree upon an adequate inspection program. Schedules should be established for lubrication of equipment. Proper care of equipment will increase the useful life of the machine.

Housekeeping - Housekeeping is maintaining the work area and its surroundings in an orderly, neat, and clean manner. Good housekeeping has many advantages to production:

- The production rate is increased by removing unnecessary materials.
- Materials, parts, and tools don't get lost.
- Safer working conditions result.
- It is easier to repair machines.
- Fire hazards are eliminated.
- Cleaning is easier.
- Morale of the workers is increased.

Good housekeeping has many advantages; there are no disadvantages to a clean and orderly work area.

Bottlenecks - A bottleneck occurs when the rate of production of one work station is slower than the rest of the line. The best way to prevent a bottleneck is through advance planning where the work is divided up so that the amount of time to do individual operations does not vary greatly.

One solution to a bottleneck would be to put more workers at the bottleneck to alleviate congestion. Time and motion studies may be used to help eliminate bottlenecks.

A good point to remember is that a production line can never be faster than its slowest part.

Packaging - Packaging serves the purpose of protecting goods, making them readily movable. This includes a container for the product, as well as the housing around the components. An example would be the cabinet around radio components. The two major functions of packaging are:

- Decorative Packaging - to furnish sales appeal.
- Protective Packaging - to provide protection, control the quantity or size of the unit, and provide a suitable means of containing the material during movement or storage. Protective packaging guards against foreign materials, temperature changes, insects, moisture and shock.

Both decorative and protective packages can be made from wood, paper, metal, glass, plastic or cloth.

CHAPTER IX

MARKETING THE PRODUCT

Marketing is essentially selling the product, but marketing today involves many more functions than just selling.

Included as functions of marketing today are:

- Market research (previously discussed in Chapter III)
- Advertising - public announcement of product or services for sale.
- Selling the product.
- Servicing the product after the sale.

Advertising

After the market research has been performed and it has been established that people will buy the product, it is necessary to let the public know that you have a product for sale. If no one knows you have a product on the market, you won't sell it.

Methods of advertising include:

Newspapers and magazines

Radio and television

Billboards

Mailed circulars

Any of the above methods of advertising tell the prospective customer

- That you have a product to sell.
- What the product can do.
- Where they can buy it.
- The price.
- How to use the product.

A poster for product promotion is shown in figure 9-1.

Why do people buy products? People buy products for many reasons and each of these reasons can be grouped in one of the three categories below:

1. For rational reasons - that is, after thinking about their needs and the products available, they decide to buy.

2. For emotional reasons - this is also known as impulse buying, where there is no apparent thought given to the purchase; fads - part of the in-group.
3. Patronage buying - is where a customer continually buys from one store or one brand of products because they have served his purposes well and he feels an allegiance or obligation to buy from a particular merchant or a particular product.

Fig. 9-1 Advertising Poster

Marketing Channels

When the product leaves the production operation, it must become available to the buyer. This can be done in a number of ways.

Retailing: which is selling to the customer who purchases the product with the intent of using

it. Retail sales can be made in a variety of ways which include:

Door to door sales

Mail order

Retail stores

Sales from the factory

Wholesaling: which is where the customer buys goods to resell them for a profit. The wholesale buying of products is made by:

Warehouses

Wholesalers

Selling the Product

Once the customer is aware that a product exists and it is available for his purchase, he still may not buy it unless someone sells him the product.

The selling process generally consists of:

Getting prospects - identifying people who can use the product.

Approaching the prospect - getting his attention and interest.

Showing the product - demonstrating what it will do.

Closing the sale - getting the order for the product.

Following up the sale - telling the customer he has made a wise decision.

Pricing the Product

In classroom production, labor may or may not be figured into the cost of the product. Refer back to the cost statement in Chapter VII for the cost of production. From these figures you may determine the cost per item and add your profit margin.

In order to determine a price for the product several methods are available. One point must be kept in mind. If the price is too high, no one will buy it; if the price is too low, you may not be making a fair profit. A compromise between these two extremes must be reached.

Prices for a new product can be determined by:

1. Setting the price close to that of other similar products.
2. Guessing - price the product; if it is wrong, change it.
3. Use market research to determine how much people are willing to pay for the product.
4. Use the break-even chart.

Break-Even* Chart

A break-even chart can be used to show the number of sales you will need to make before you can start making profit from your product. The break-even chart is also useful in determining the selling price of the product.

Figure 9-2 shows a break-even chart with three different selling prices for the same product. You will note that at $1.50 per item you can break even at 12 products, at $1.00 per item break-even is at 16 products, and at 80 cents the break-even point is 20 products. It can be seen that as the selling price goes down, the number of products that must be sold to break even goes up.

The horizontal line running across at $8.00 represents the fixed costs or those costs that stay the same whether you produce one or a hundred products. Examples of fixed costs are rent, taxes, and insurance.

The shaded areas represent the loss taken or the profit if production is stopped at any one point.

Notice that the line representing the direct cost of the product starts at $8.00. This is because the cost of the product is added on to the overhead or fixed costs.

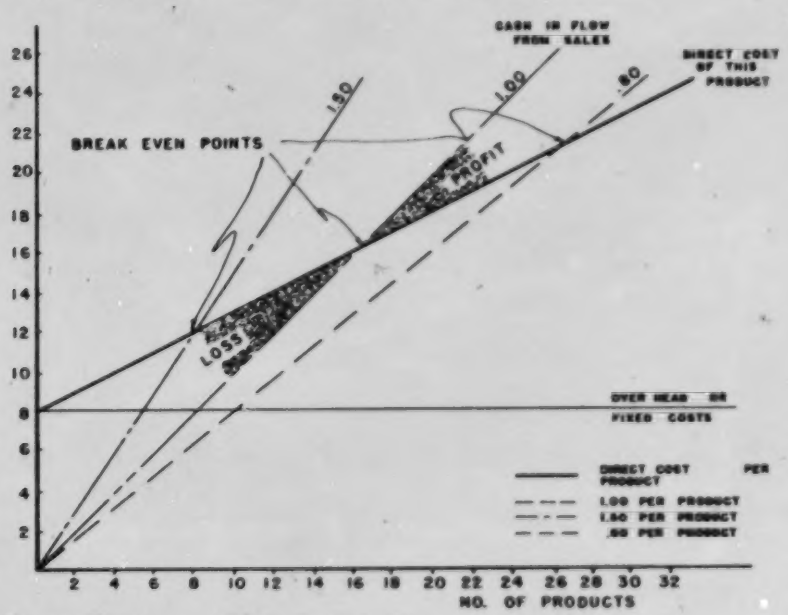


Fig. 9-2 Break-even Chart

* To break even is to take in the same amount of money as it costs to produce a product. At this point a company doesn't lose money, but it doesn't make any money either.

Sales Report

A sales report gives an up-to-date account of the products that have been sold. Figure 9-3 is an example of a sales report that can easily be used in the classroom.

The vice president in charge of sales will want to use this or a similar form for his job.

SALES REPORT

A.B.C. LETTER COMPANY

DATE	NUMBER SOLD	PRICE OF PRODUCT	TOTAL SALES TODAY	CUMULATIVE SALES TO DATE
5/1	5	$1.00	$5.00	$ 5.00
5/2	3	1.00	3.00	8.00
5/3	6	1.00	6.00	14.00
5/4	2	1.00	2.00	16.00

Fig. 9-3

Cumulative Sales Chart

The cumulative sales chart plots the number of sales over any given period of time, usually days. This chart allows the students to easily see the progress they are making in merchandising their product. A sample sales chart is shown in figure 9-4.

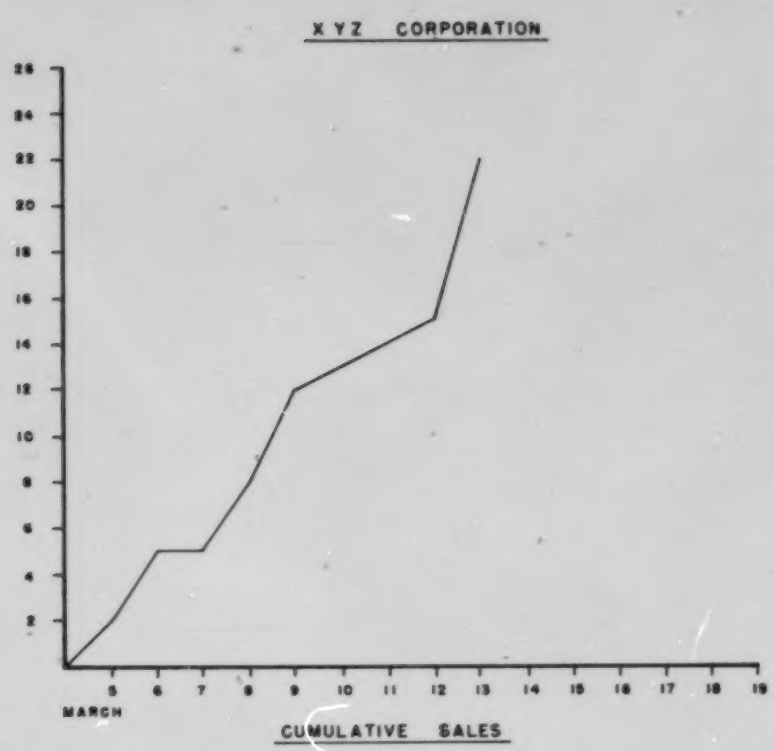


Fig. 9-4 Cumulative Sales Chart

CHAPTER X

TERMINAL ACTIVITIES

The following procedures may be used to terminate the mass production activities. Once the sales have been made, all bills for materials and the expenses of operation must be paid. A profit and loss statement is prepared at this time which helps determine the income for the operation. The profits can be distributed now or held for reinvestment.

Dissolving a Corporation

If the class has formed a corporation, it must be dissolved, and this takes place when there is no longer any purpose or need for doing business.

A corporation may be dissolved by:

- Voluntary action - which is the decision of the corporation to dissolve.
- Involuntary action - which is brought about without the consent of the corporation. An example would be when the charter expires or when creditors sue for unpaid bills, or when the state revokes its charter.

When a corporation is dissolved it ceases to exist; it cannot conduct business, it cannot sue or be sued.

Arizona requires certain steps in dissolving a domestic corporation (one that has been incorporated with the State of Arizona). These procedures are shown in figure 10-1. Circled items are the steps for a domestic corporation and items 2, 3, 4, 5, and 6 are necessary for withdrawing a foreign corporation (one that has its charter in another state but is doing business in this state).

In addition to the legal steps involved in dissolving a corporation, all the assets of the corporation must be liquidated (turned into cash), the unpaid bills must be taken care of, a call for the collection of stocks given, and the remaining money divided among the stockholders.

Figure 10-2 shows a Resolution of Dissolution which is issued after a corporation is legally dissolved.

Student Evaluation

Evaluation can be carried out for both the student and the teacher.

RUSSELL WILLIAMS
CHAIRMAN
CHARLES H. GARLAND
COMMISSIONER
AL FARON
COMMISSIONER

WILLIAM R. JOHNSON
EXECUTIVE SECRETARY

ARIZONA CORPORATION COMMISSION
STATE CAPITOL ANNEX
PHOENIX

Gentlemen:

The _____ will be filed for

_____

upon receipt of items checked below.

1. RESOLUTION OF DISSOLUTION (original only) certified by President and Secretary.
2. WITHDRAWAL (Form enclosed).
3. RELEASE from Sales & Use Tax Division of the Arizona State Tax Commission.
4. RELEASE from Income Tax Division of the Arizona State Tax Commission.
5. CHECK in the amount of $11.00. ($10.00 for filing Resolution and $1.00 for revoking Agent.)
6. ANNUAL REPORT and ANNUAL FEE for the years all reports must be up to date (SEE REPORT FORM ATTACHED.)
7. CHECK STALE, dated, please issue new check for same.
8. AFFIDAVIT OF PUBLICATION of Notice of Proposed Dissolution, or Dissolution may be by UNANIMOUS WRITTEN CONSENT of the Shareholders. (Dept of Law Oponion No. 70-3 (R-35).

*9. We are returning enclosed DOCUMENTS, Corporation has been revoked as of _____.

RELEASES -- The Corporation must request releases from State Sales and Income Tax Divisions. Request must be made to each Division.

Cordially,

ARIZONA CORPORATION COMMISSION
Incorporating Division

* When a corporation has failed to pay the Registration fee or file the annual report for two years, the Commission shall revoke the Certificate of Incorporation and License.

Fig. 10-1 Steps necessary in dissolving a corporation.

STATE OF ARIZONA

Corporation Commission

To all to Whom these Presents shall Come, Greeting:

I, SECRETARY OF THE ARIZONA CORPORATION COMMISSION, DO HEREBY CERTIFY THAT the records in this office show that

a corporation incorporated on the day of and existing under and by virtue of the laws of the State of Arizona, filed in the office of the Arizona Corporation Commission, a RESOLUTION OF DISSOLUTION, and on the day of completed all requirements necessary for the filing of said Resolution of Dissolution and thereupon ceases to exist, except as to creditors.

IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND AFFIXED THE OFFICIAL SEAL OF THE ARIZONA CORPORATION COMMISSION, AT THE CAPITOL, IN THE CITY OF PHOENIX, THIS DAY OF A. D.

BY SECRETARY,

FORM NO. 378-B 9-68 5M ASSISTANT SECRETARY

Fig. 10-2 Resolution of Dissolution

Standard evaluation procedures can be used for the students with a culminating examination at the close. Total student evaluation should also include daily instructor observations of each student's manipulative and social-personal skills.

Teacher Evaluation

Having students evaluate the teacher always stimulates the students and after the teacher carefully sifts the student evaluations he can find many good ideas for improving his methods of conducting the class.

Student Critique of Course Material*

The critique gives the student an opportunity to express his thoughts and feelings about the mass production activities just completed. This can be a written or oral activity. Unsigned written critiques provide opportunities for anonymous comments from the students.

*Critique: a careful analysis or review of an activity, especially concerned with those good and bad aspects of the activity.

CHAPTER XI

IMPLEMENTING MASS PRODUCTION IN THE CLASSROOM

The following pages include teacher and student made materials used in the teaching of mass production. These materials are presented as a guide from which the individual teacher may expand and develop his own materials.

This chapter includes the Sequence of Instruction and the sketches, working drawings, and documents for mass producing a chandelier.

A set of 35mm slides depicting the mass production of the chandelier is available through the State Department of Vocational Education. For information contact:

State Supervisor of Industrial Arts
Division of Vocational Education
1535 W. Jefferson
Phoenix, Arizona 85013

Sequence of Instruction

The following is a suggested plan for sequencing instructional activities:

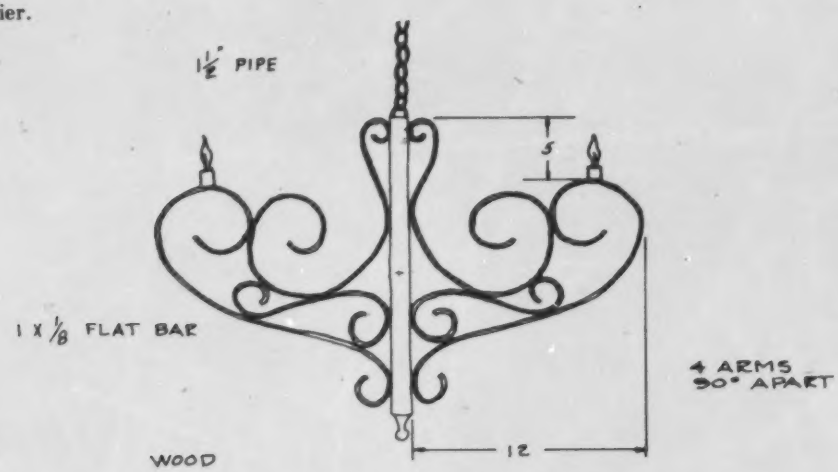
INFORMATIVE EXPERIENCES	MANIPULATIVE EXPERIENCES
1. History of mass production.	
2. Principles of Mass production	
3. Research and development	
a. Ideation	Develop ideas for a product
b. Sketching	Sketch the ideas
c. Model building	Build models from detailed sketches
d. Prototyping	Building prototypes
e. Market surveys	Conduct a market survey for each prototype
f. Feasibility study	Conduct a feasibility study for each prototype
g. Working drawings (optional)	Develop working drawings

INFORMATIVE EXPERIENCES	MANIPULATIVE EXPERIENCES
h. Bill of materials.	Write up bill of materials
4. Business organization and finance Proprietorship Partnership Corporation	Set up a corporation structure in the classroom
5. Management and organization	Set up management structure
6. Methods of obtaining capital	Obtain capital or credit
7. Procuring materials	Find out current prices and sources of materials
8. Supporting documents PERT or Production Chart Progress report Flow diagram Job descriptions Production cost statement Operation sheets Profit and Loss statement	Plan entire mass production operation with a PERT chart or Production chart may be used in place of PERT chart Set up progress report forms Develop a flow diagram for the classroom Write necessary job descriptions Develop a production cost statement Develop operation sheets
9. Pilot run Operator training Arrangement of equipment Tooling up Materials handling	Train students for work at individual stations Arrange equipment using flow diagram Tool up and make jigs or fixtures Set up material handling methods and procedures

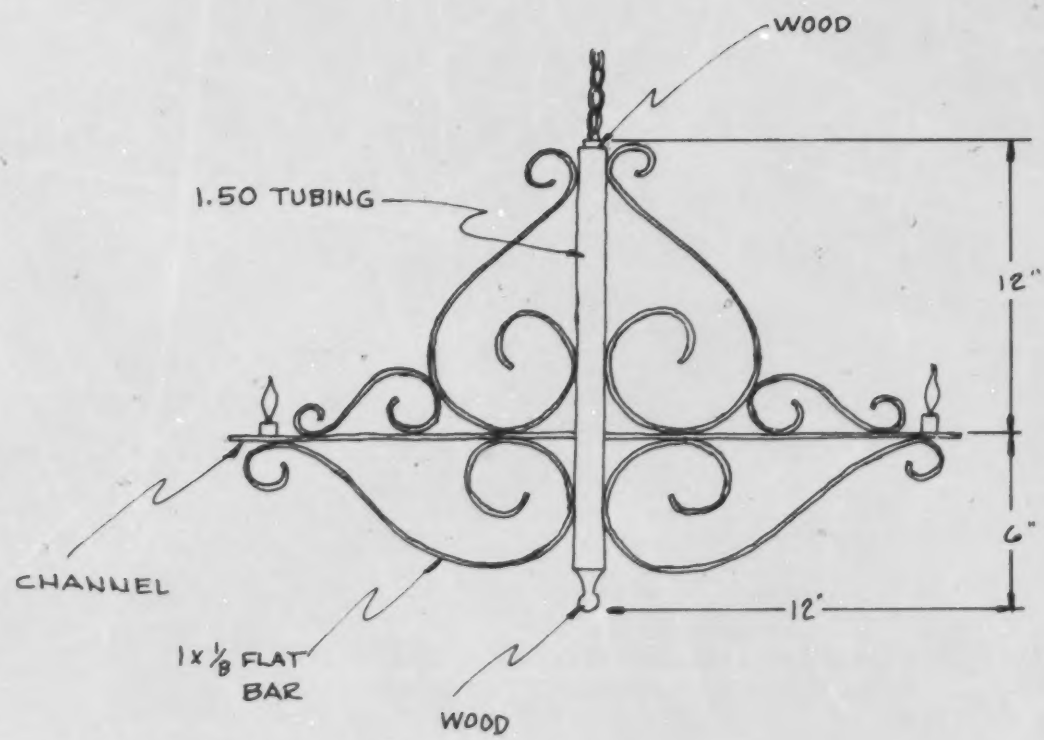
INFORMATIVE EXPERIENCES	MANIPULATIVE EXPERIENCES
Quality control	Establish location for quality control
	Develop quality control devices
Packaging	Develop a package
	Make the pilot run
	Make necessary adjustments or changes
10. Production	
On the job training	
Preventive maintenance	Decide where and when preventive maintenance will be given
Housekeeping	Decide what housekeeping will be done and when
Bottlenecks	Make production runs
11. Marketing	
Advertising	Develop posters and other media for the product
Pricing the product	Develop break-even chart
	Decide on a price
Sales	Develop a sales report and sales chart
12. Terminal Activities	
Profit and Loss statement	Prepare profit and loss statement
	Distribute the profits
Dissolving a corporation	Dissolve the corporation
Evaluation	Comprehensive examination
	Student critique

Mass Producing a Chandelier

The following section represents the teaching aids and materials for classroom production of a chandelier.



Preliminary Sketch No. 1



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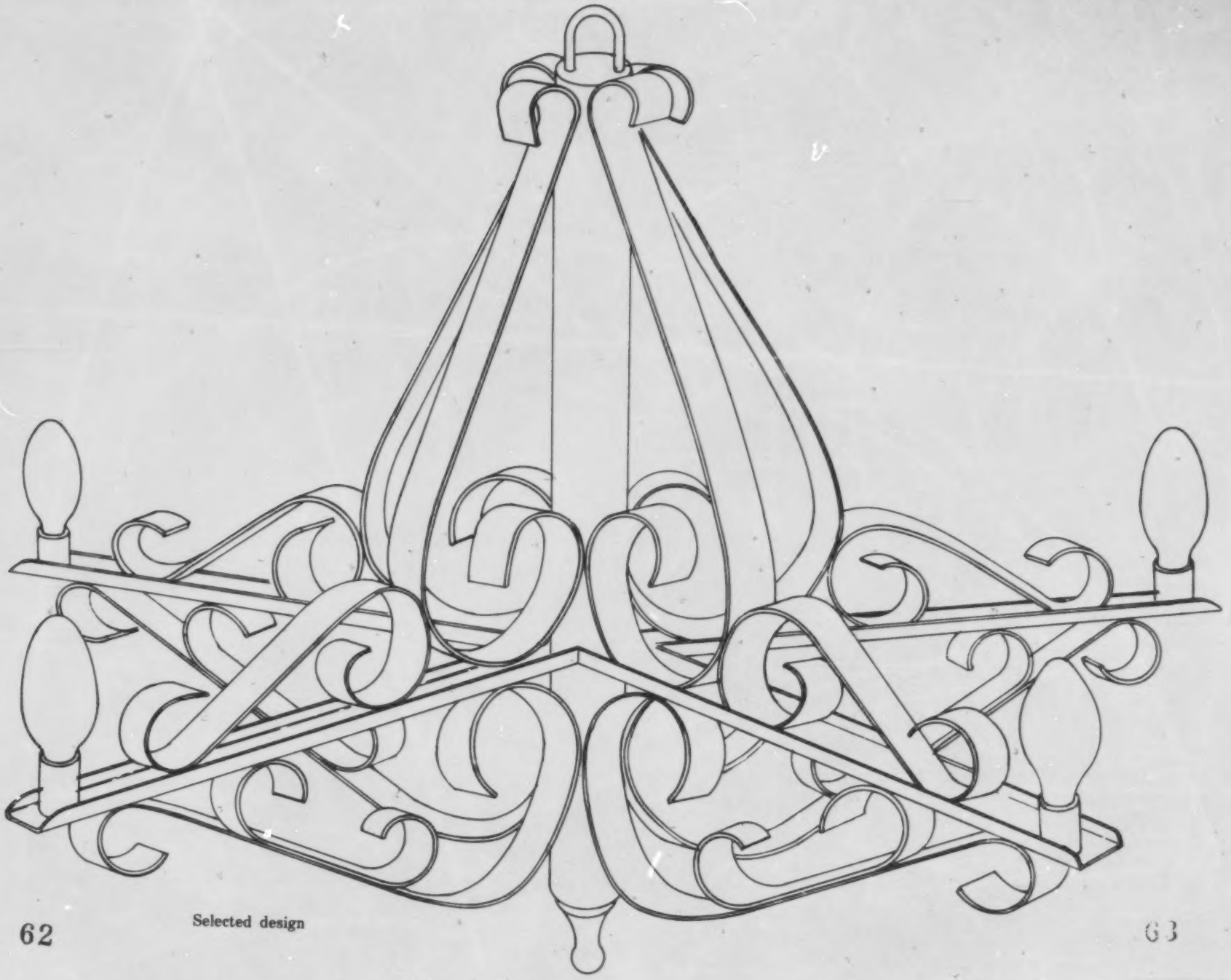
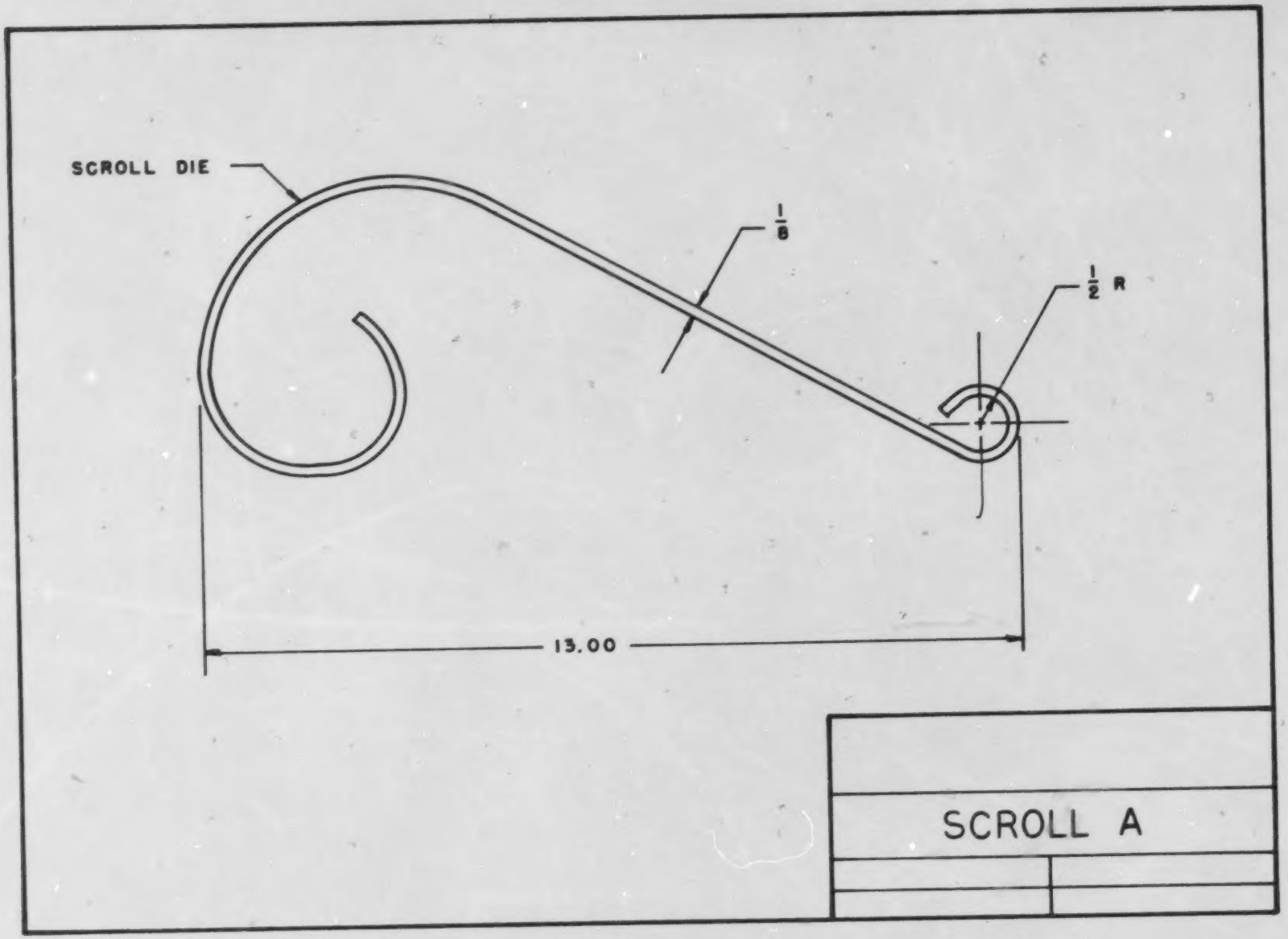
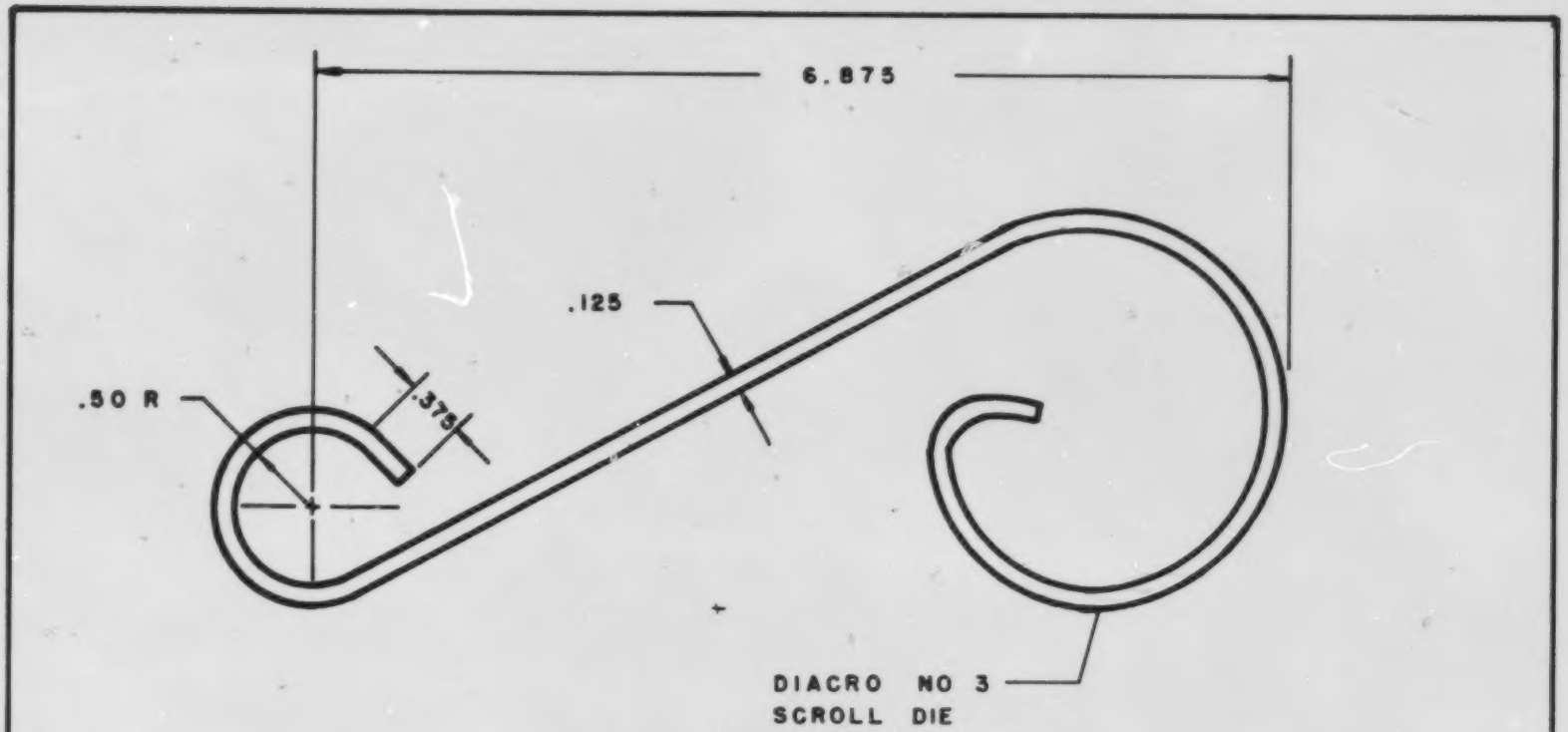


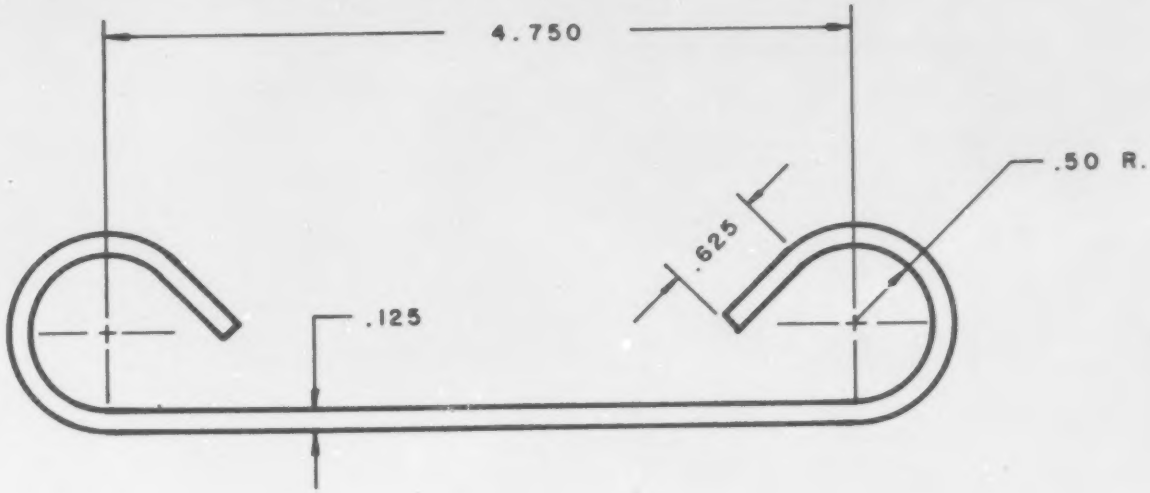
62 Selected design 63


SCROLL DIE
1/8
1/2 R
13.00
SCROLL A



MAT'L

SCROLL B



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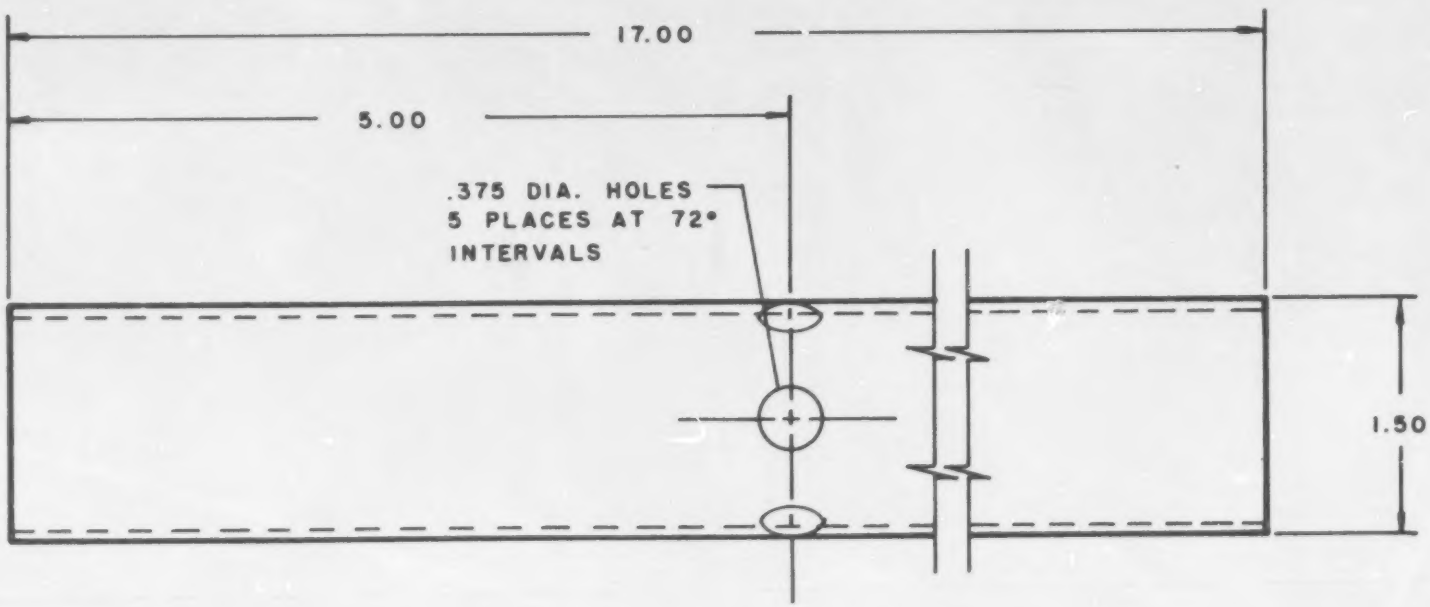
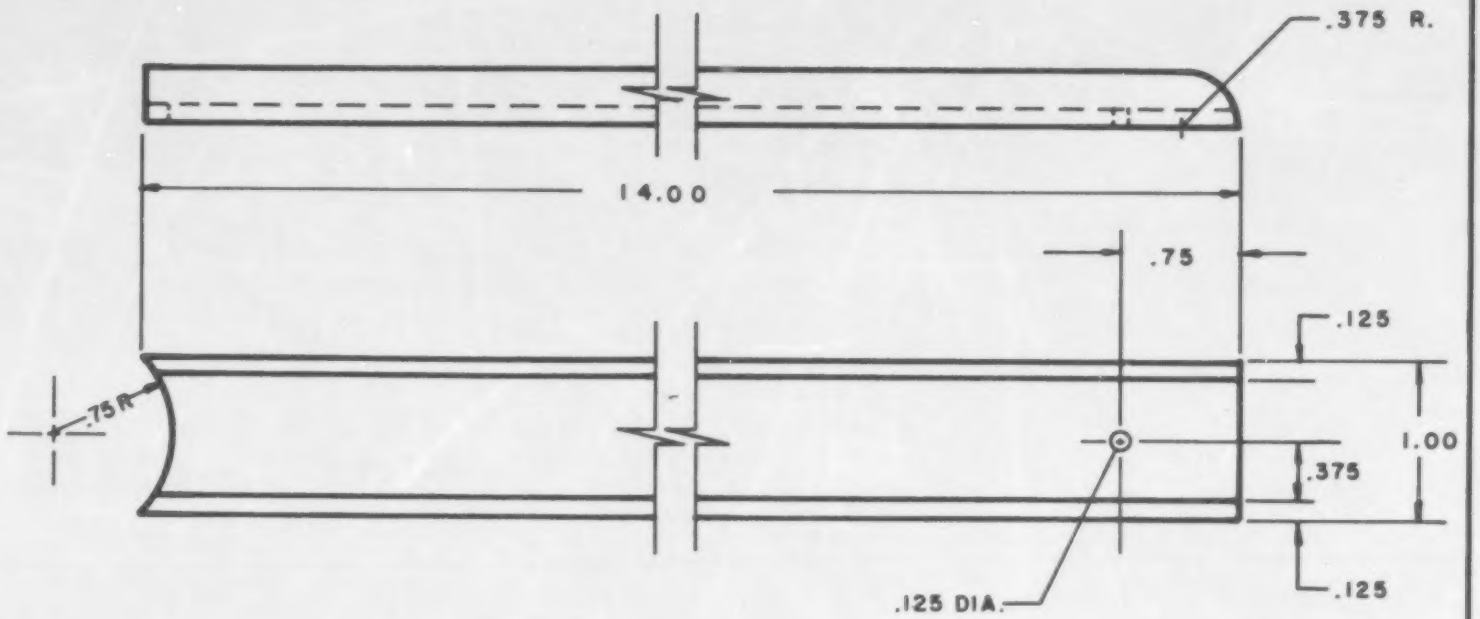
SCROLL C



MAT'L

1.50 DIA. ELECT. CONDUIT

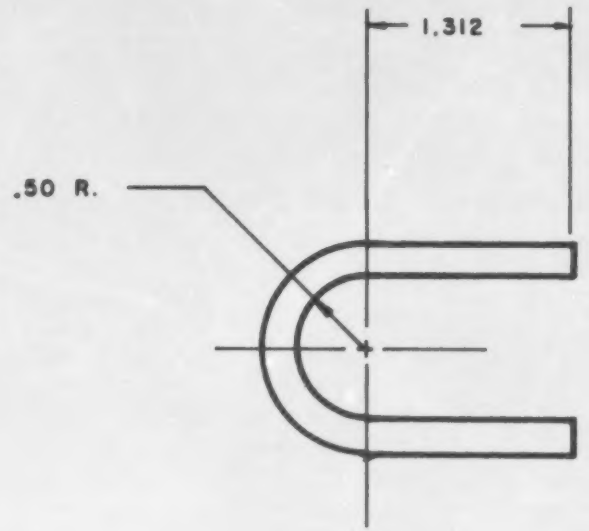
CENTER BODY



MAT'L

1.00 X .375 STEEL CHANNEL

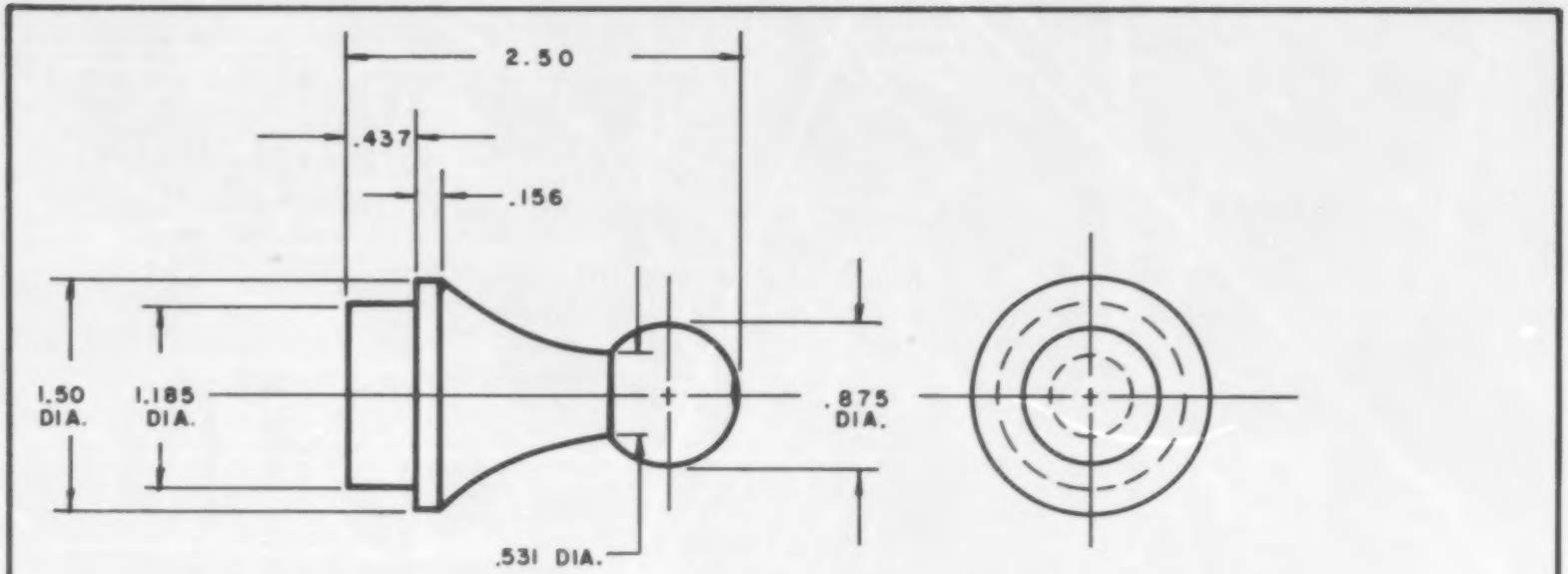
HORIZONTAL ARM



MAT'L

.187 C.R.S. ROD

U-BRACKET



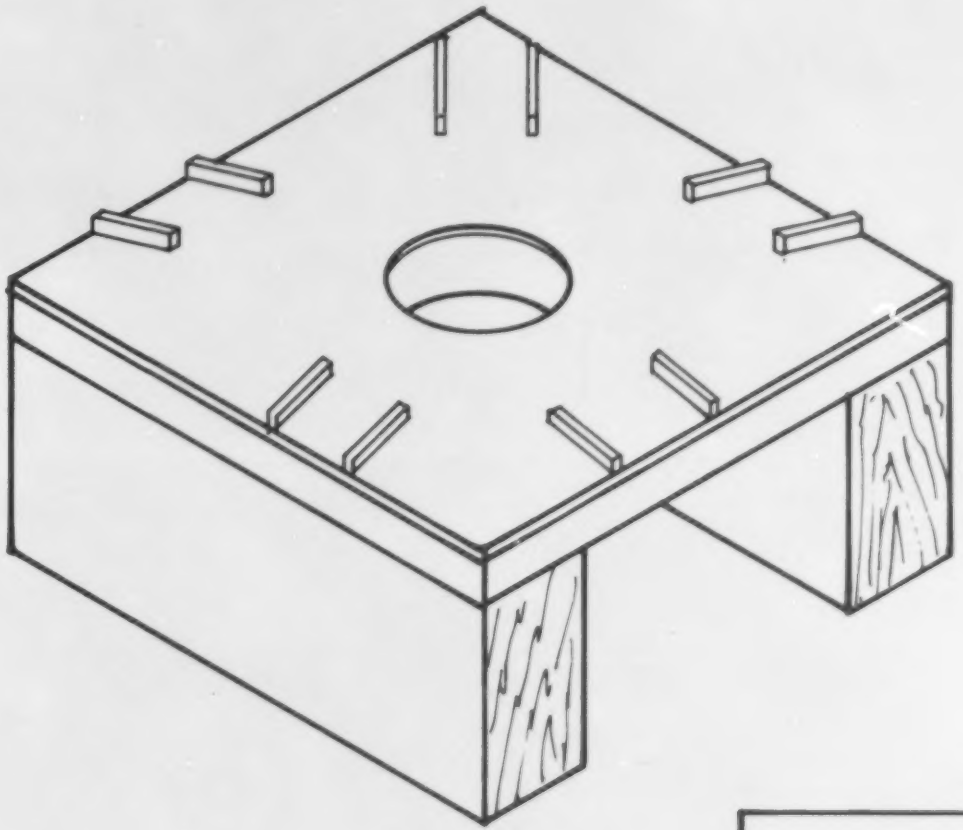
MAT'L

WOOD

FINIAL

76

76A



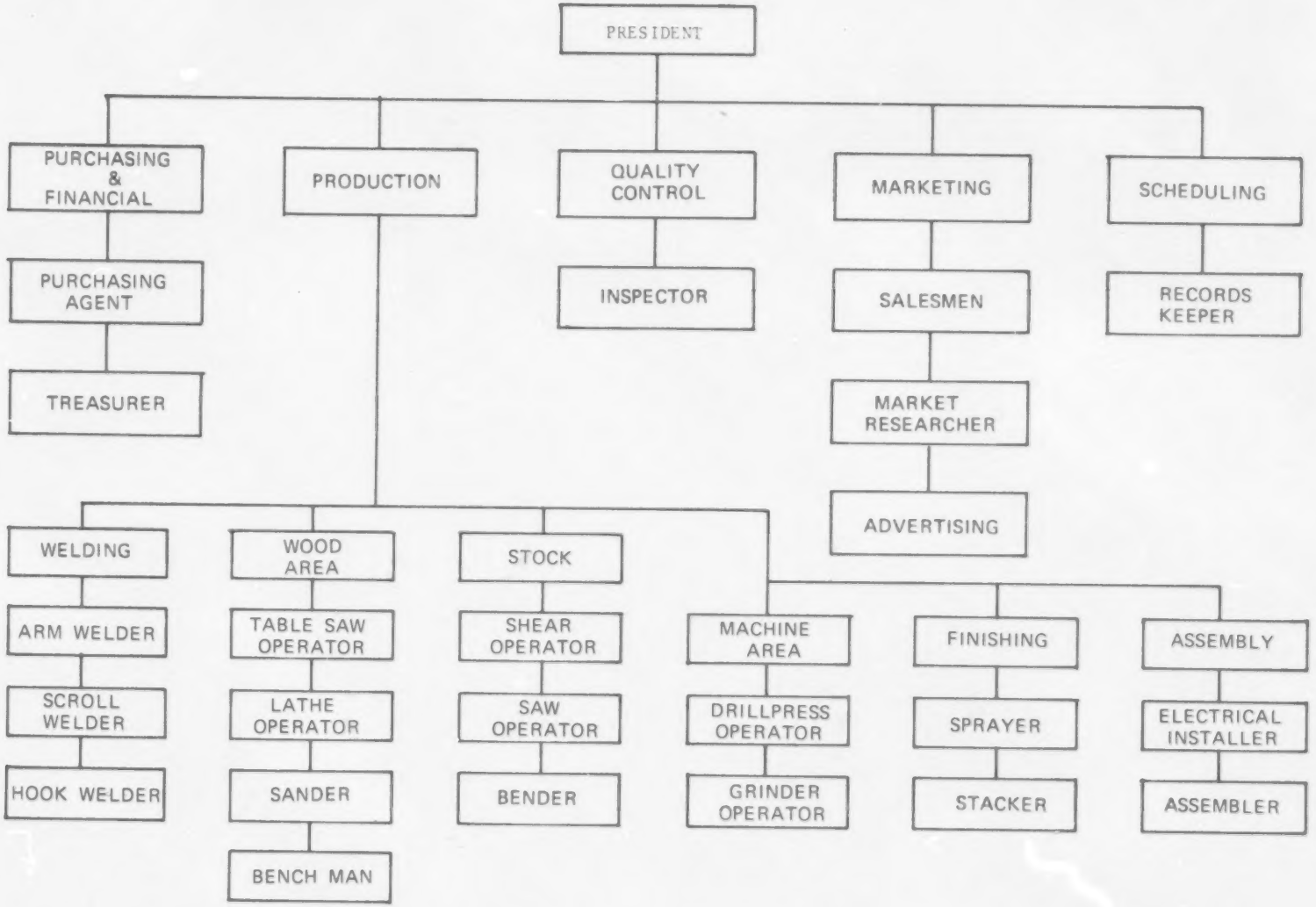
WELDING FIXTURE

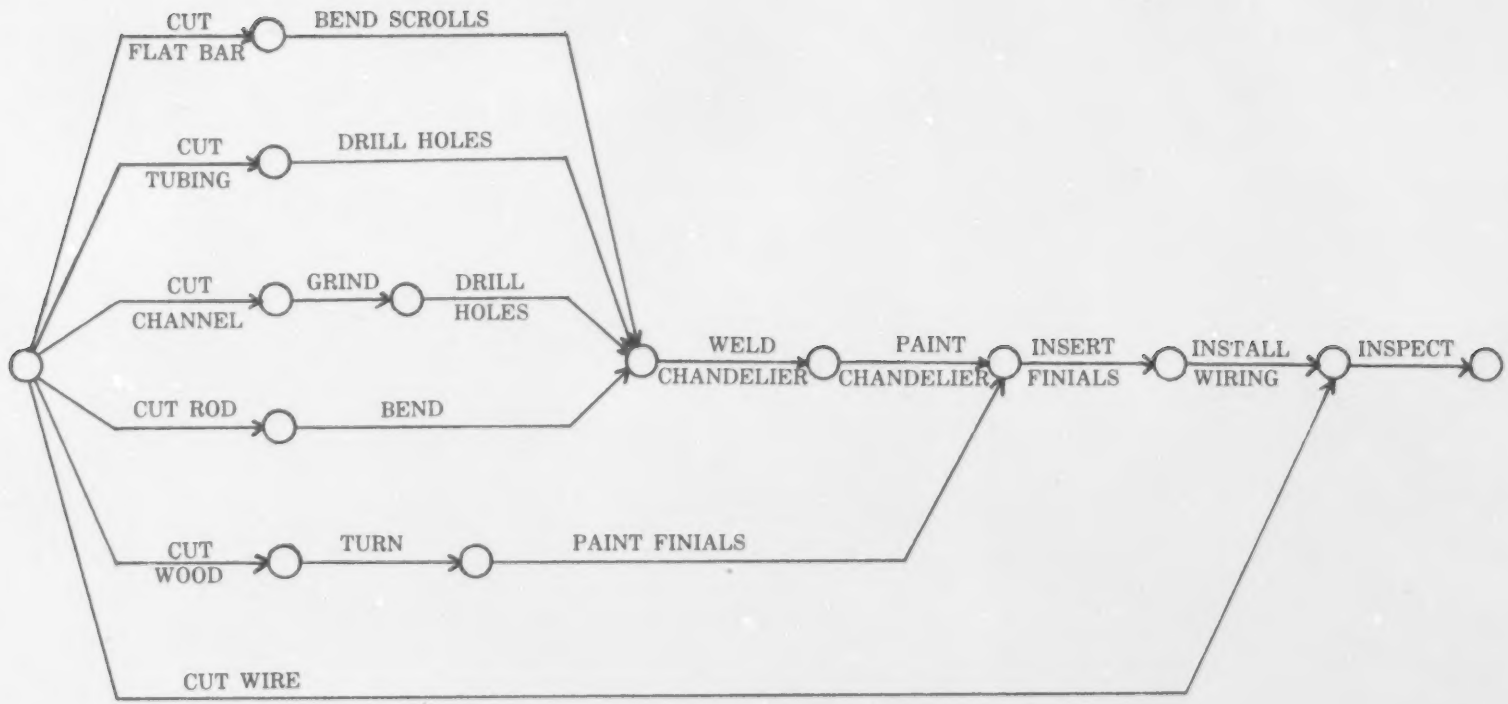
BILL OF MATERIALS

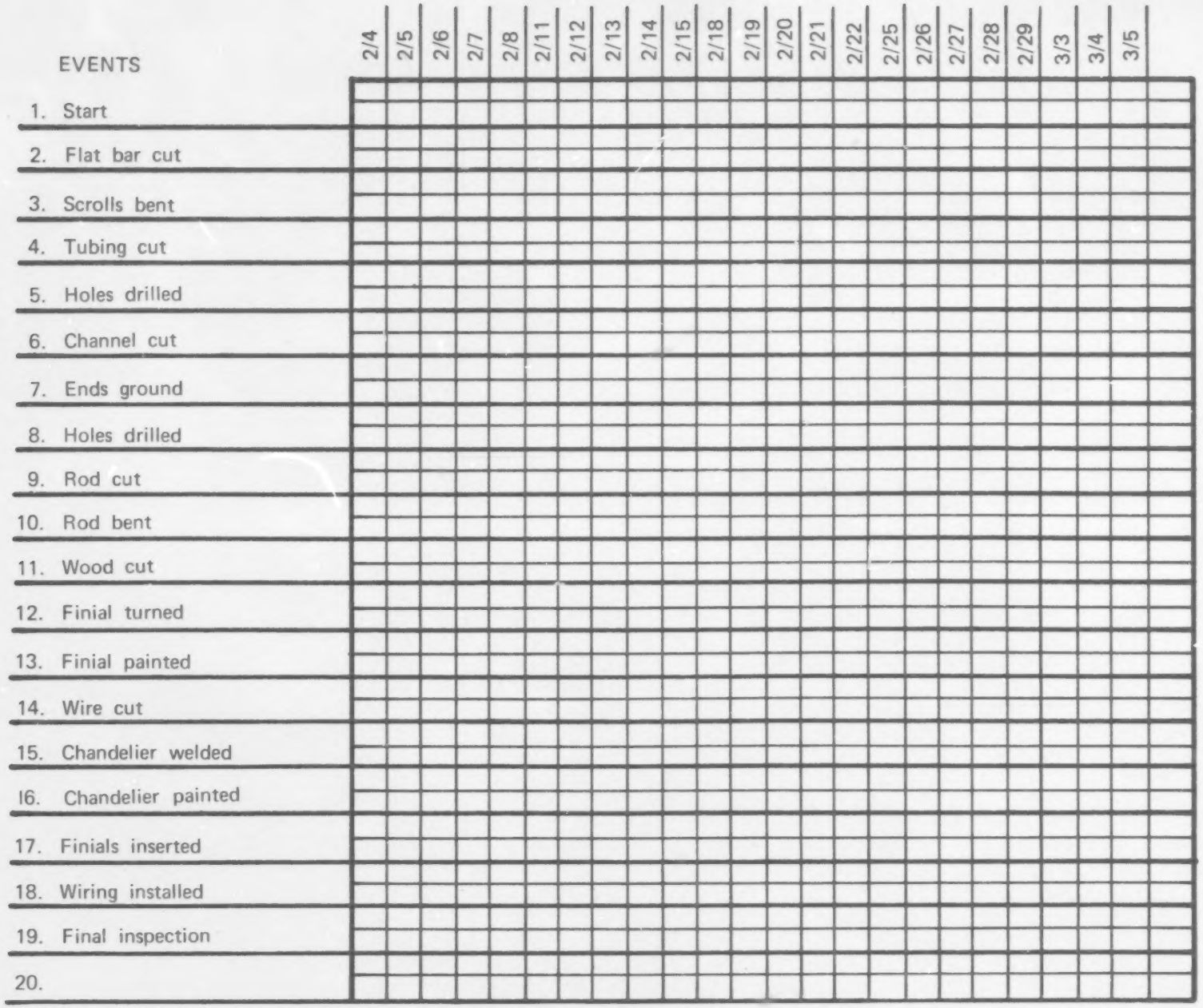
24 Chandeliers

Quantity	Description	Price
840 ft.	1/8x1 flat bar steel	$ 73.56
120 ft.	1" channel steel	22.50
30 ft.	1½" electrical conduit	7.56
305 ft.	18-2 electrical wire	24.30
120 ea.	#3 sockets	30.00
72 oz.	paint, spray, flat black	13.50
1 gal	paint thinner	1.68
120 ea.	washers	2.40
48 ea.	wire nuts	3.96
120 ea.	machine screws 6-32x½	2.70
6 bd.ft.	wood (lauan)	5.40
		$187.56

Cost of each chandelier - - - - - - $7.82


PRESIDENT
PURCHASING & FINANCIAL
PRODUCTION
QUALITY CONTROL
MARKETING
SCHEDULING
PURCHASING AGENT
INSPECTOR
SALESMEN
RECORDS KEEPER
TREASURER
MARKET RESEARCHER
ADVERTISING
WELDING
WOOD AREA
STOCK
MACHINE AREA
FINISHING
ASSEMBLY
ARM WELDER
TABLE SAW OPERATOR
SHEAR OPERATOR
DRILLPRESS OPERATOR
SPRAYER
ELECTRICAL INSTALLER
SCROLL WELDER
LATHE OPERATOR
SAW OPERATOR
GRINDER OPERATOR
STACKER
ASSEMBLER
HOOK WELDER
SANDER
BENDER
BENCH MAN


CUT
FLAT BAR
BEND SCROLLS
CUT
TUBING
DRILL HOLES
CUT
CHANNEL
GRIND
DRILL
HOLES
CUT ROD
BEND
CUT
WOOD
TURN
PAINT FINIALS
CUT WIRE
WELD
CHANDELIER
PAINT
CHANDELIER
INSERT
FINIALS
INSTALL
WIRING
INSPECT


EVENTS
2/4
2/5
2/6
2/7
2/8
2/11
2/12
2/13
2/14
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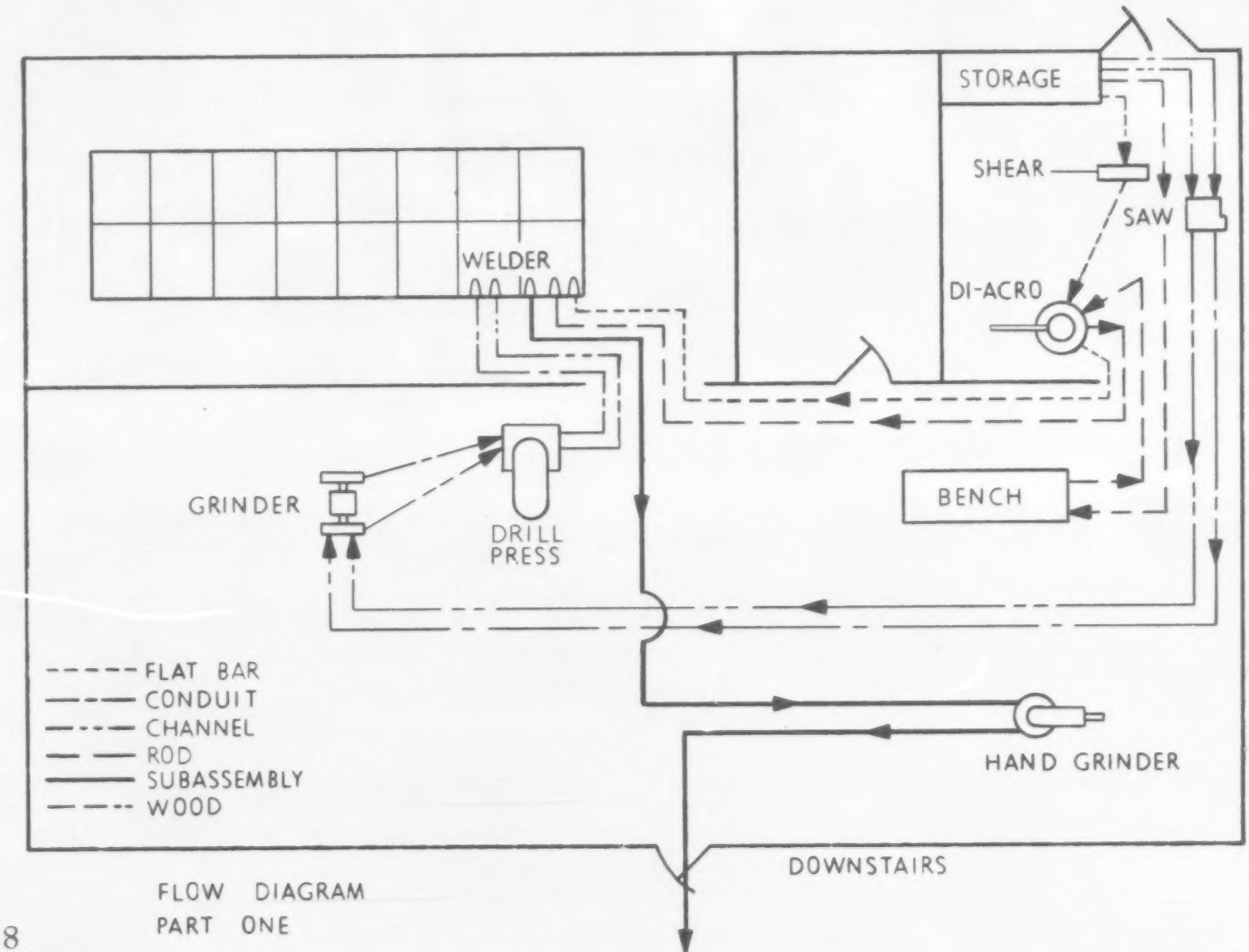
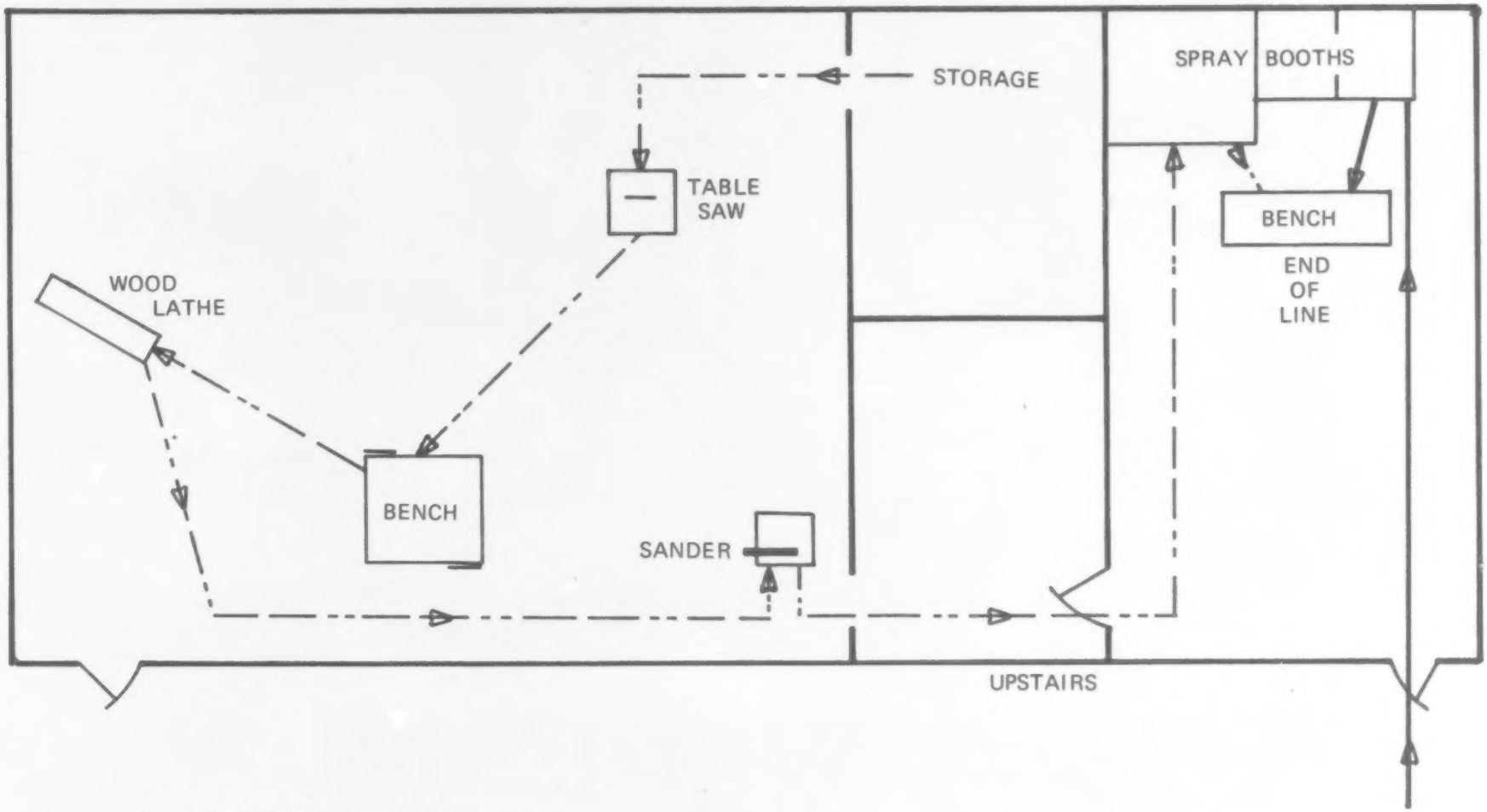
2/19
2/20
2/21
2/22
2/25
2/26
2/27
2/28
2/29
3/3
3/4
3/5
1. Start
2. Flat bar cut
3. Scrolls bent
4. Tubing cut
5. Holes drilled
6. Channel cut
7. Ends ground
8. Holes drilled
9. Rod cut
10. Rod bent
11. Wood cut
12. Finial turned
13. Finial painted
14. Wire cut
15. Chandelier welded
16. Chandelier painted
17. Finials inserted
18. Wiring installed
19. Final inspection
20.

PROGRESS REPORT

ACTIVITY NUMBER AND DESCRIPTION	ESTIMATED TIME MAN HOURS	PERCENT COMPLETED					MAN HOURS THIS WEEK	CUM. MAN HOURS
		25%	50%	75%	100%			



FLOW DIAGRAM
PART ONE



FLOW DIAGRAM
PART TWO

OPERATION SHEET

PART NAME: SCROLL-A

MATERIAL: FLAT BAR CRS SIZE: 1/8X1X24

QUANTITY: 80

DRAWING NO. 1

NOTES: Finished length of 13 inches

OPER. NO.	TOOL	OPERATIONS
1	shear	Cut to length
2	die	Bend large scroll
3	die	Bend small scroll

OPERATION SHEET

PART NAME: SCROLL-B

MATERIAL: FLAT BAR SIZE: 1/8X1X14

QUANTITY: 40

DRAWING NO. 2

NOTES: Finished length of 6 7/8 inches

OPER. NO.	TOOL	OPERATIONS
1	shear	Cut to length
2	die	Bend large scroll
3	die	Bend small scroll

93

OPERATION SHEET

PART NAME: SCROLL-C

MATERIAL: FLAT BAR SIZE: 1/8X1X10

QUANTITY: 40

DRAWING NO. 3

NOTES: Finished length of 6 inches

OPER. NO.	TOOL	OPERATIONS
1	shear	Cut to length
2	die	Bend first scroll
3	die	Bend second scroll

OPERATION SHEET

PART NAME: HORIZONTAL ARM

MATERIAL: CHANNEL SIZE: 3/8X1X14

QUANTITY: 40

DRAWING NO. 4

NOTES:

OPER. NO.	TOOL	OPERATIONS
1	saw	Cut to length
2	grinder	Form 3/8" radius on end
3	grinder	Form 3/4" concave radius
4	drill press	Cut 1/8" hole

OPERATION SHEET

PART NAME: CENTER BODY

MATERIAL: CONDUIT SIZE: 1½X17

QUANTITY: 8

DRAWING NO. 5

NOTES:

OPER. NO.	TOOL	OPERATIONS
1	saw	Cut to length
2	grinder	Remove flashing on both ends.
3	drill press	Drill 5 holes at 72° intervals.

OPERATION SHEET

PART NAME: U-BRACKET

MATERIAL: COLD ROLLED STEEL SIZE: 3/16X4¼

QUANTITY: 8

DRAWING NO. 6

NOTES:

OPER. NO.	TOOL	OPERATIONS
1	saw	Cut to length
2	diacro	Bend

OPERATION SHEET

PART NAME: FINIAL

MATERIAL: WOOD (LAUAN) SIZE: 1 3/4X1 3/4X4

QUANTITY: 8

DRAWING NO. 7

NOTES:

OPER. NO.	TOOL	OPERATIONS
1	saw	Cut to width
2	saw	Cut to length
3	lathe	Turn to dimensions
4	saw	Cut off ends
5	sander	Smooth ends
6	spray booth	Paint

SUPERIOR LIGHTING COMPANY

JOB DESCRIPTION

SCROLL WELDER Department: Welding

Summary of Job

Attaches scrolls A, B, and C to subassembly as per specifications

Duties

1. Visually aligns scrolls in proper position.
2. Tack weld scrolls in position.
3. Verify proper alignment and finish weld.
4. Remove slag.
5. Is able to determine proper welding current.

Worker Specifications

Prior training is required to become familiar with welding techniques. Must be familiar with safety procedures.

ELEGANT LIGHTING

AT A PRICE
YOU CAN AFFORD

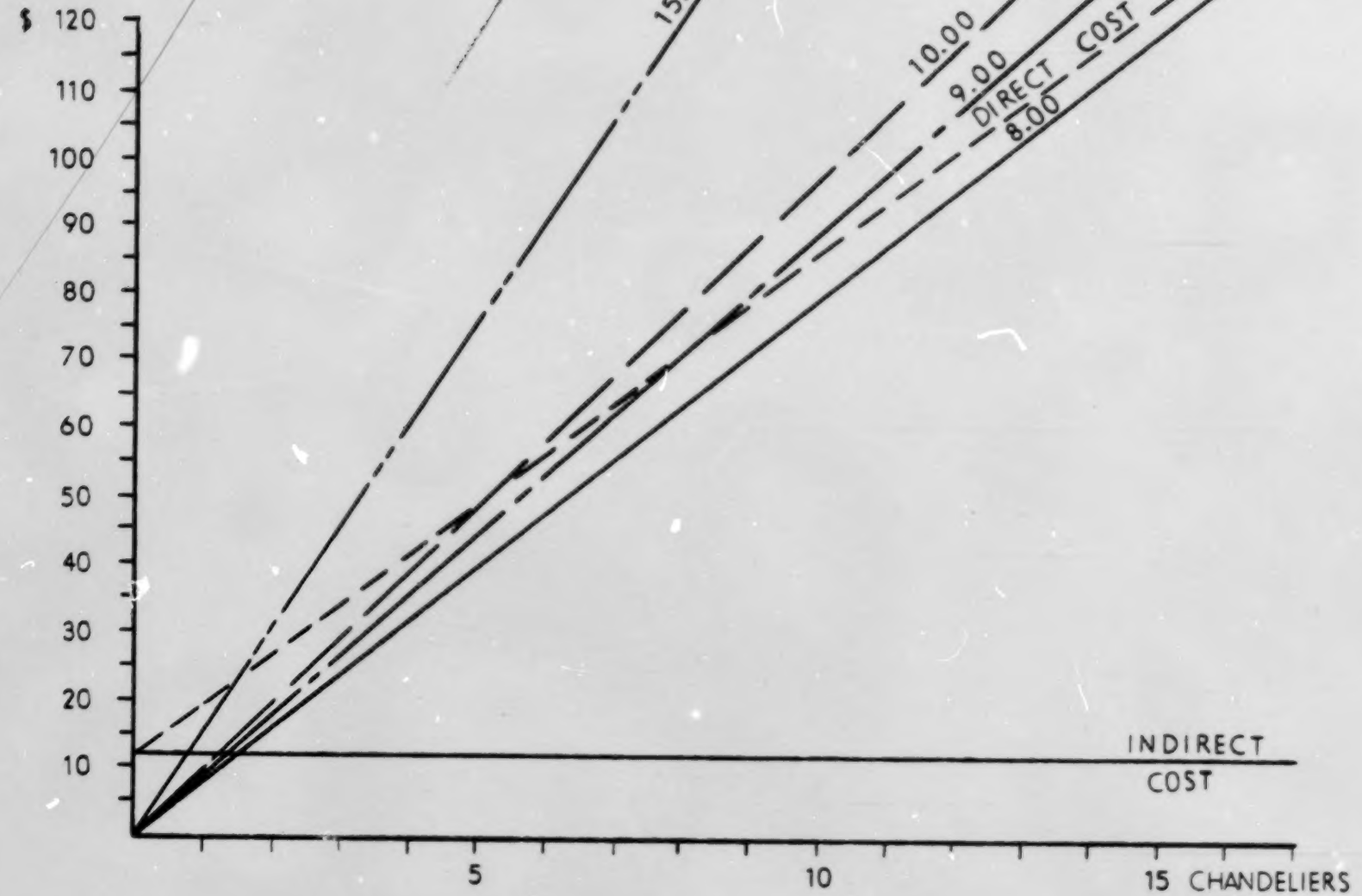
ONLY 15.00

(LESS CHAIN AND BULBS)

PRODUCTION

COST STATEMENT

DIRECT COSTS		
Materials		$ 187.56
Labor		
INDIRECT COSTS		
Machine Rental		6.00
Work Spoilage		3.20
Advertising		2.50
COST OF PRODUCTION		$ 199.26



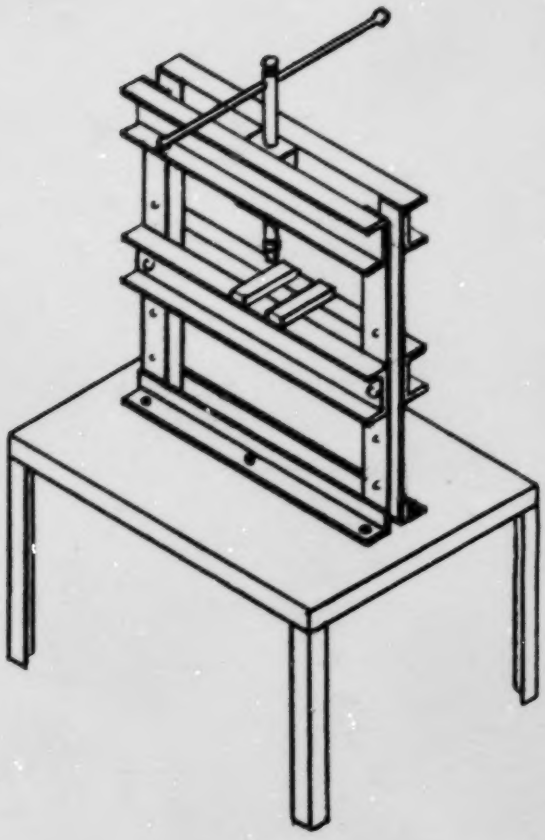
BREAK EVEN CHART

PROFIT AND LOSS STATEMENT

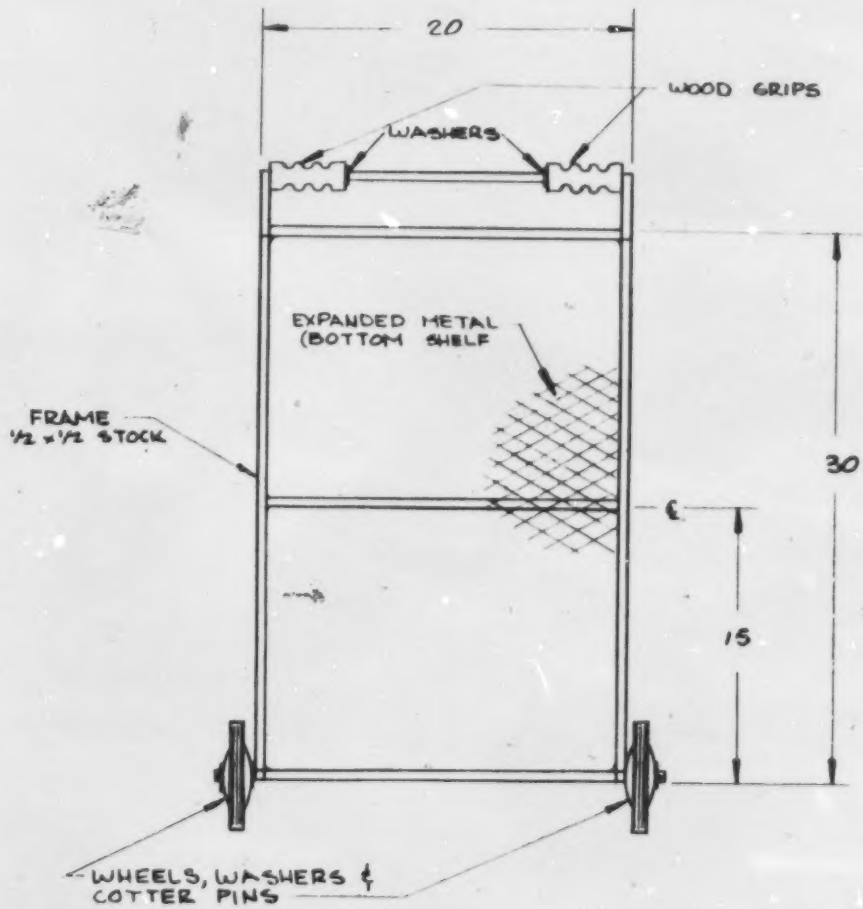
LIGHTING LIMITED

Sales	240.00	
Less cost of goods sold	187.56	
Gross margin		52.44
Expenses of Operation		
Advertising	2.50	
Rent	6.00	
Spoilage	3.20	
Less operating expenses		11.70
Operating Income		40.74

GROUP MASS PRODUCTION PROJECT

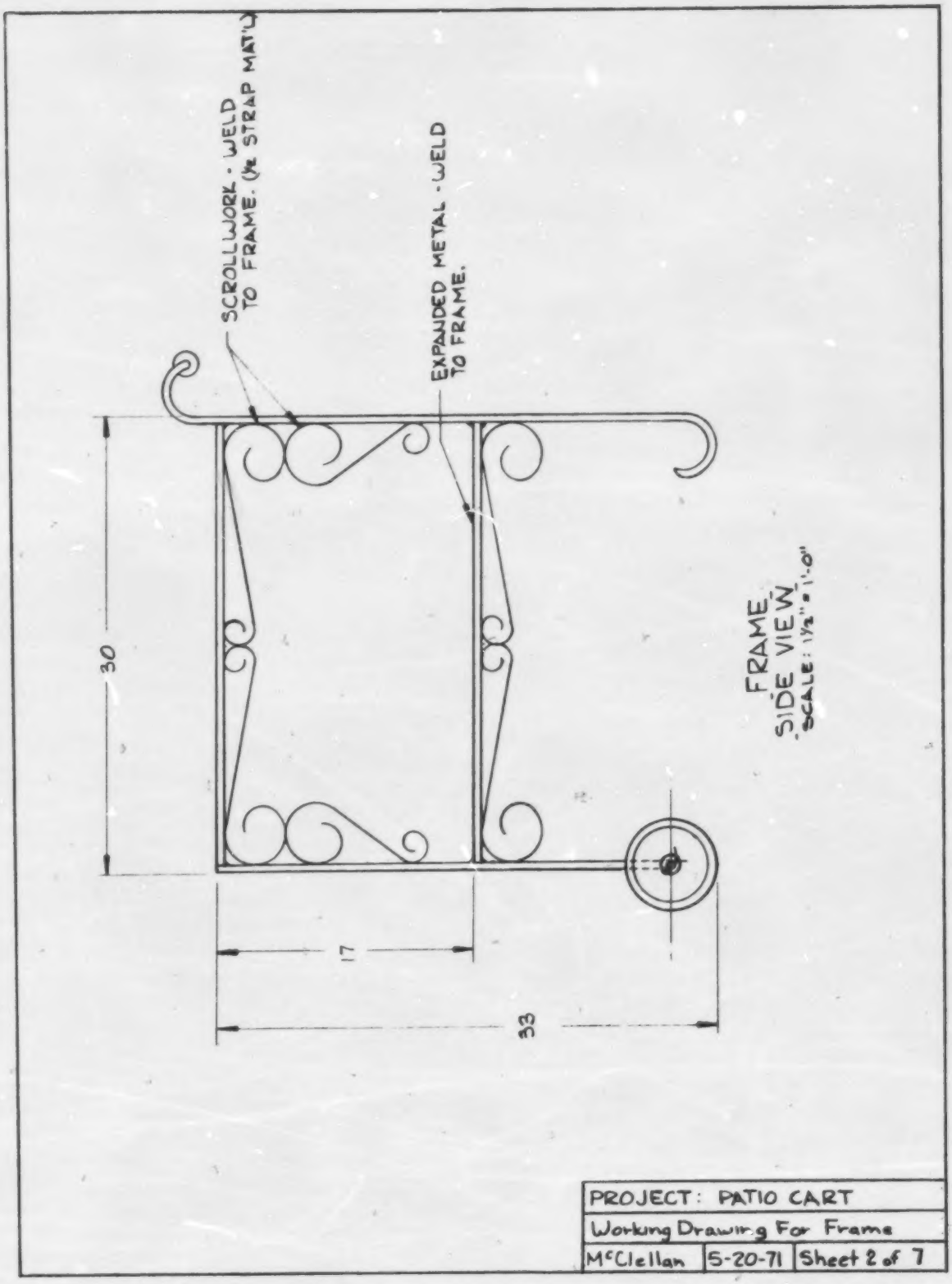


UTILITY PRESS

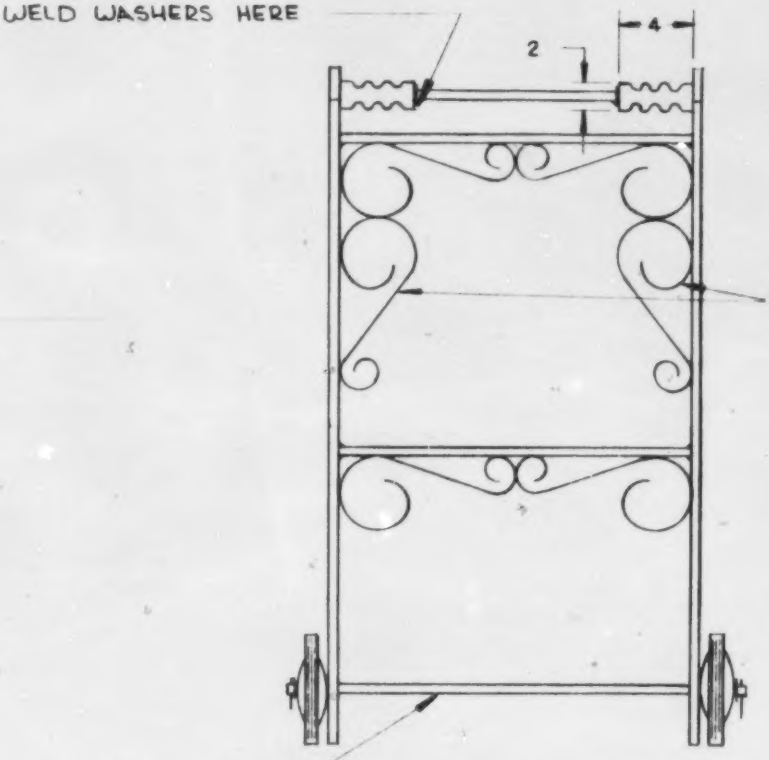


FRAME
TOP VIEW
SCALE: 1½" = 1'-0"

PROJECT: PATIO CART		
Working Drawing For Frame		
McClellan	5-20-71	Sheet 1 of 7



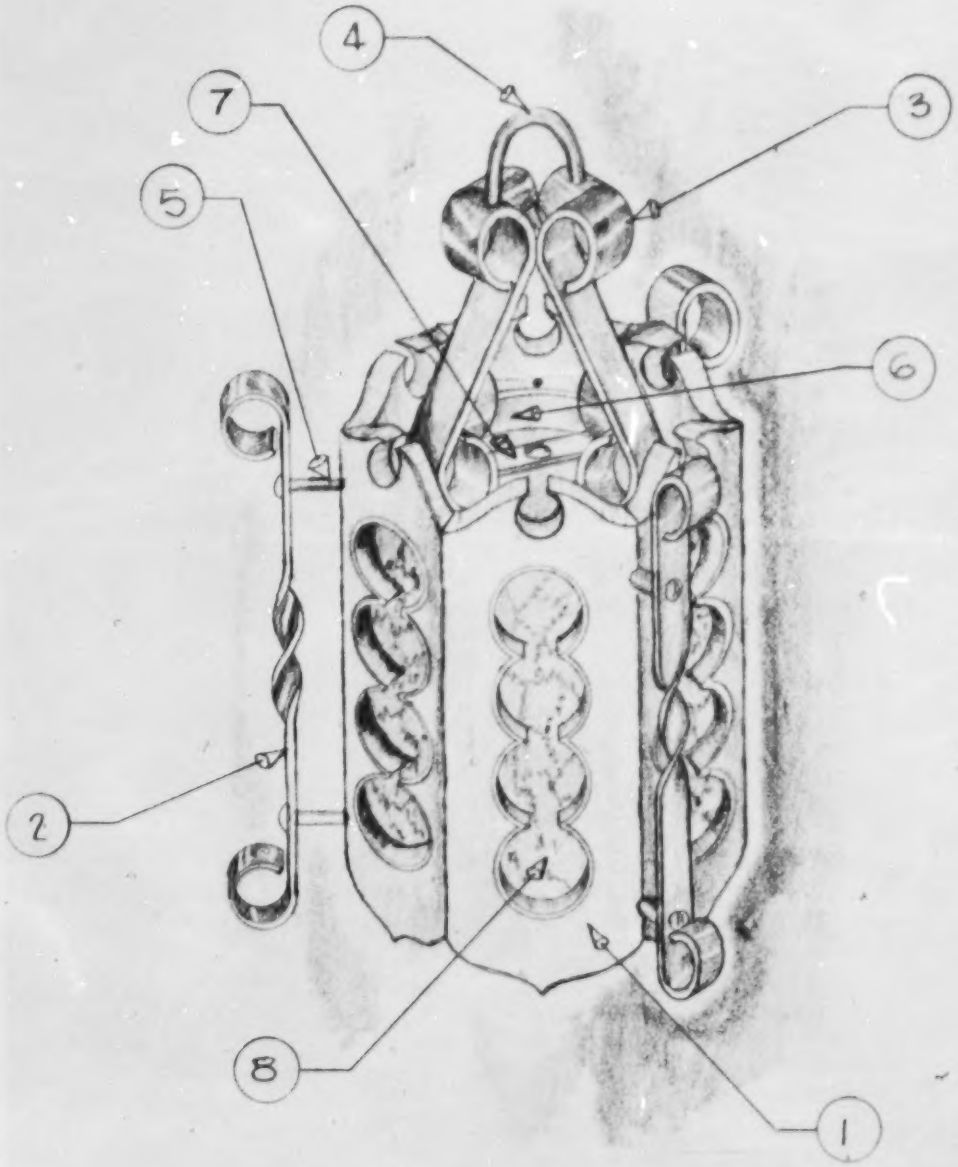
PROJECT: PATIO CART		
Working Drawing For Frame		
McClellan	5-20-71	Sheet 2 of 7



FRAME
END VIEW
SCALE: 1½" = 1'-0"

NOTE: SEE OPERATIONS FOR WELDING PROCEDURE

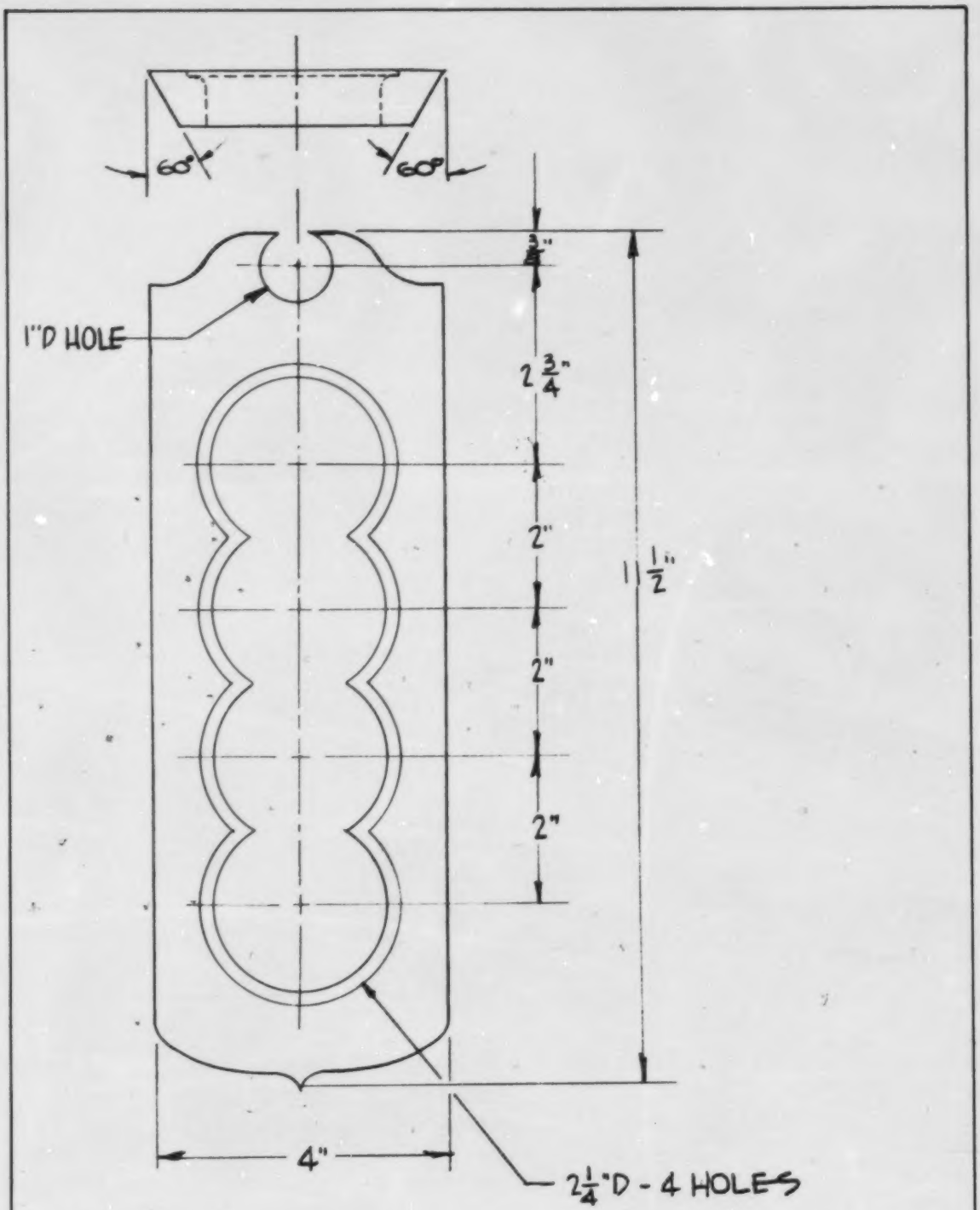
PROJECT: PATIO CART		
Working Drawing For Frame		
McClellan	5-20-71	Sheet 3 of 7



TITLE Swag Lamp	PART NAME Pictorial View	SHEET NUMBER 1 of 4 pages
COMPANY American Industry	PART NUMBER	

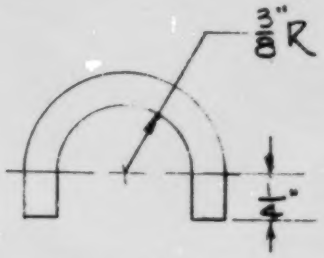
NO.	REQ'D	NAME	MAT'L	REMARKS
12				
11	12	BRADS	STEEL	$\frac{1}{2}$" LONG - FLAT HEAD
10	3	SCREWS	STEEL	$\frac{1}{8} \times \frac{1}{2}$ - ROUND HEAD
9	6	SCREWS	STEEL	$\frac{3}{16} \times 1\frac{1}{2}$ - ROUND HEAD
8	6	PLASTIC	PLASTIC	9" x 3" LONG
7	1	FLAT SUPPORT	IRON	$\frac{1}{8} \times \frac{3}{4} \times 5\frac{1}{4}$" LONG
6	1	RING	IRON	$\frac{1}{8} \times \frac{1}{2} \times 16\frac{7}{16}$" LONG
5	6	SPACER	IRON	$\frac{3}{16}$" ID TUBE
4	1	HANGER	IRON	$\frac{3}{16}$" D x ROUND BAR
3	4	TOP BRACKET	IRON	$\frac{1}{8} \times \frac{3}{4} \times$ 9" LONG - STRAP
2	3	SIDE DECORATION	IRON	$\frac{1}{8} \times \frac{1}{2} \times$ 15" LONG - STRAP
1	6	SIDE	WOOD	

TITLE Swag Lamp	PART NAME Bill of Material	SHEET NUMBER 2 of 4 pages
COMPANY American Industry	PART NUMBER	

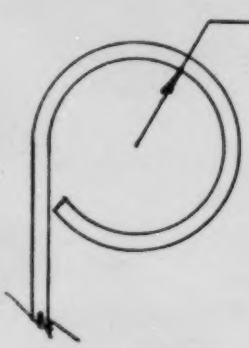


6-REQD

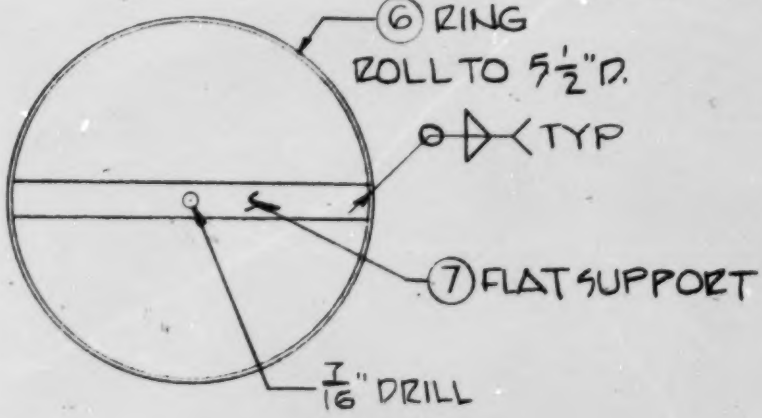
TITLE	PART NAME	SHEET NUMBER
Swag Lamp	Detail	3 of 4 pages
COMPANY	PART NUMBER	
American Industry	1	



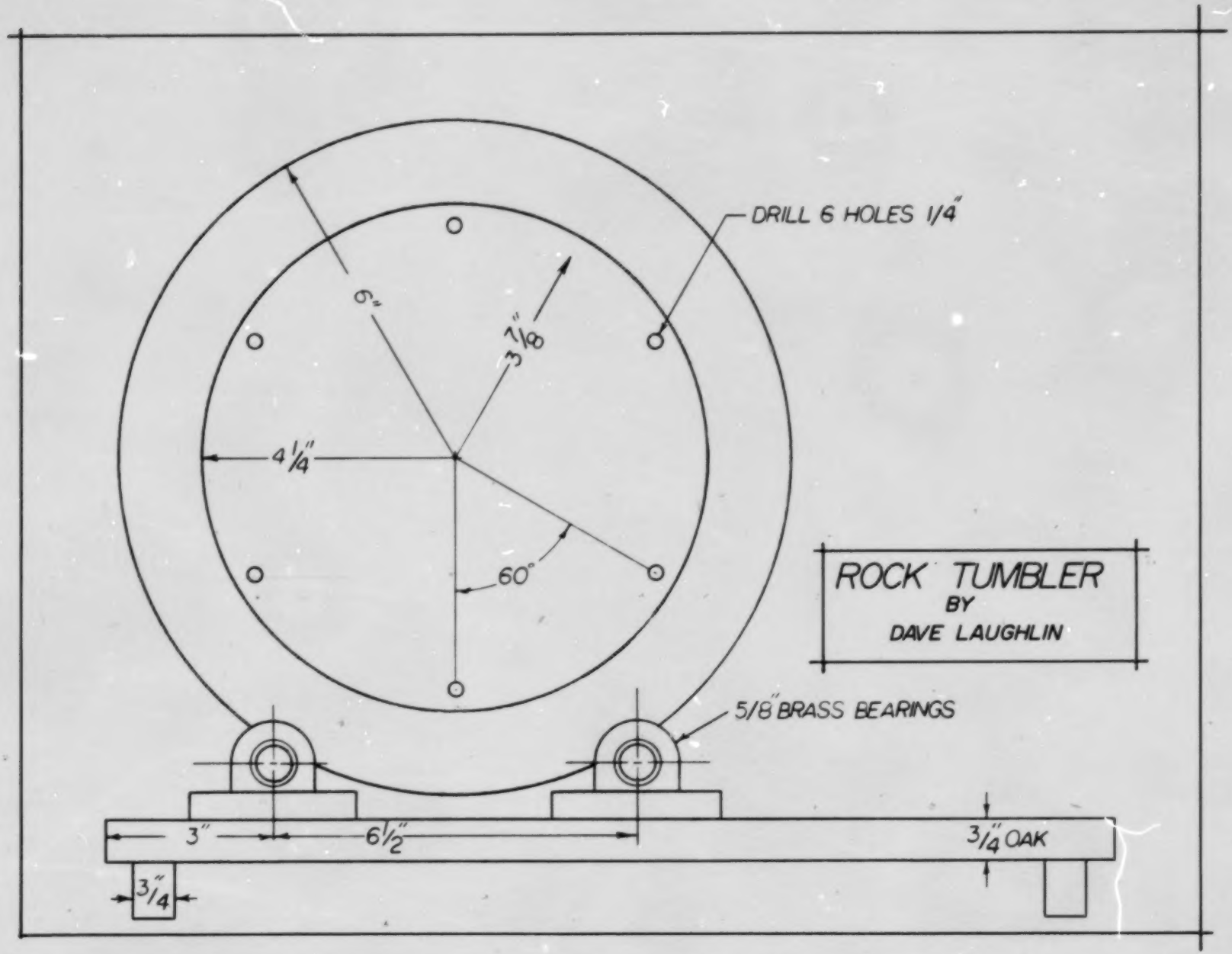
PART # 4
SCALE - FULL

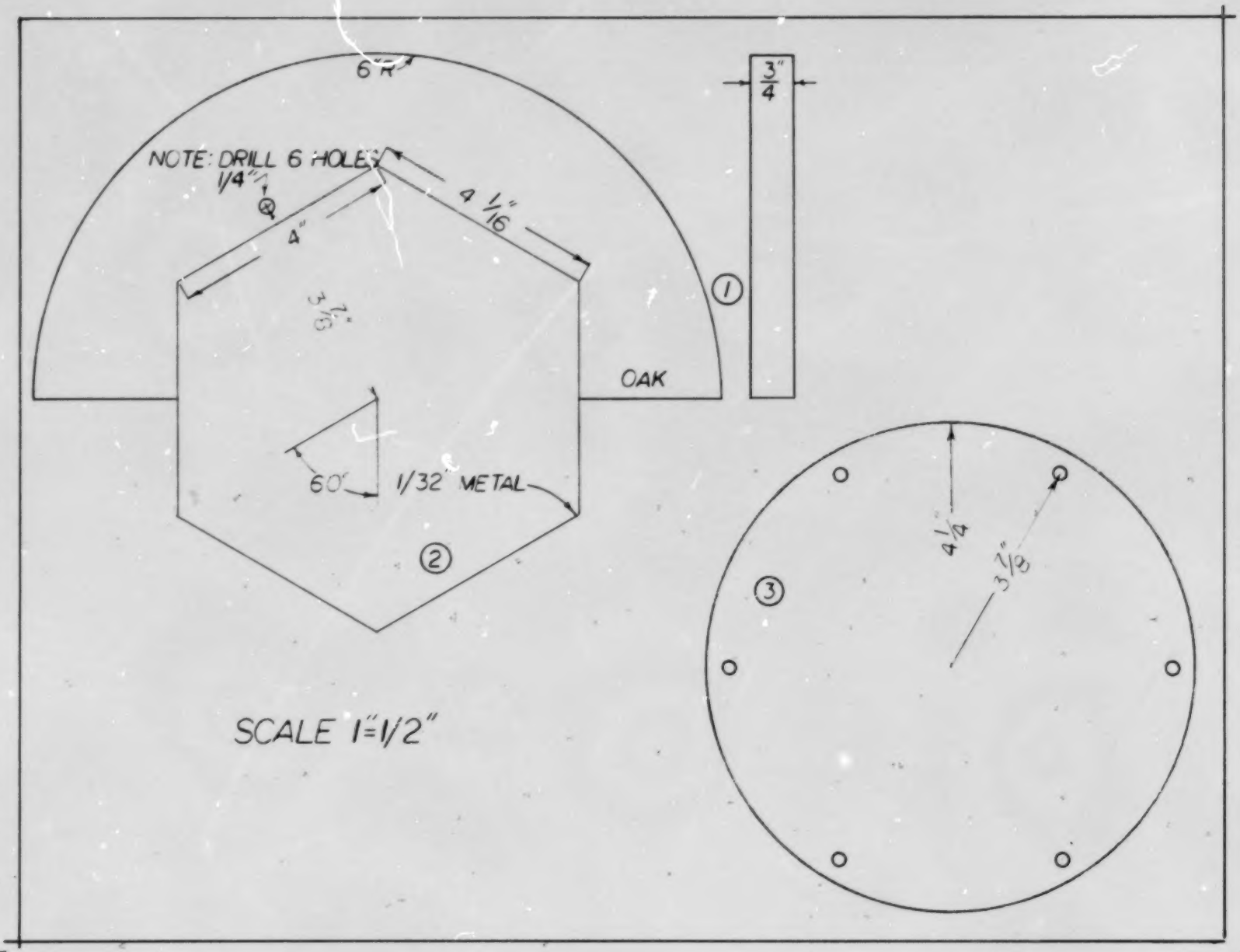


DETAIL of BEND
PARTS # 2 & 3
SCALE - FULL



TITLE	PART NAME	SHEET NUMBER
Swag Lamp	Detail	4 of 4 pages
COMPANY American Industry	PART NUMBER 2, 3 & 4	

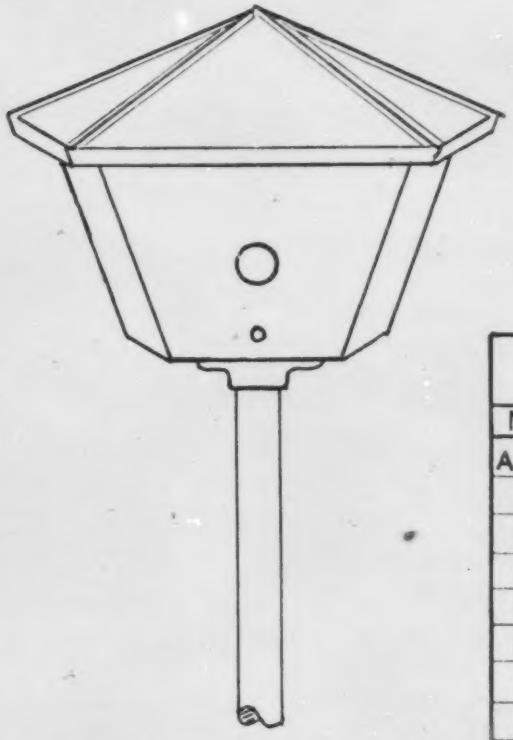

DRILL 6 HOLES 1/4"
5"
3 7/8"
4 1/4"
60°
ROCK TUMBLER
BY
DAVE LAUGHLIN
5/8" BRASS BEARINGS
3"
6 1/2"
3/4" OAK
3/4"


6" R
NOTE: DRILL 6 HOLES
1/4"
4"
4 1/16"
3 7/8"
OAK
3/4"
1
60°
1/32" METAL
2
4 1/4"
3 7/8"
3
SCALE 1"=1/2"

BILL OF MATERIALS

PART	NUMBER NEEDED	DESCRIPTION
1	2	12" ROLLERS, 3/4" OAK
2	1	HEXAGON CONTAINER, 1/32" X 8" X 24" SHEET METAL
3	2	14" PLASTIC, 8 1/2" CIRCLES
4	4	5/8" BRASS BEARINGS
5	2	5/8" REDI-ROD, ONE 12", ONE 13"
6	1	OAK PLATFORM 3/4" X 12" X 18"
7	24	CAIRAGE BOLTS, 1/4" X 1 1/2"
8	1	MOTOR, 1/4 HORSE

The following ten pages describing a pentagon birdhouse are included to present an example of how a "traditional" project can be redesigned to become an example of a vehicle to develop the concepts of mass production.

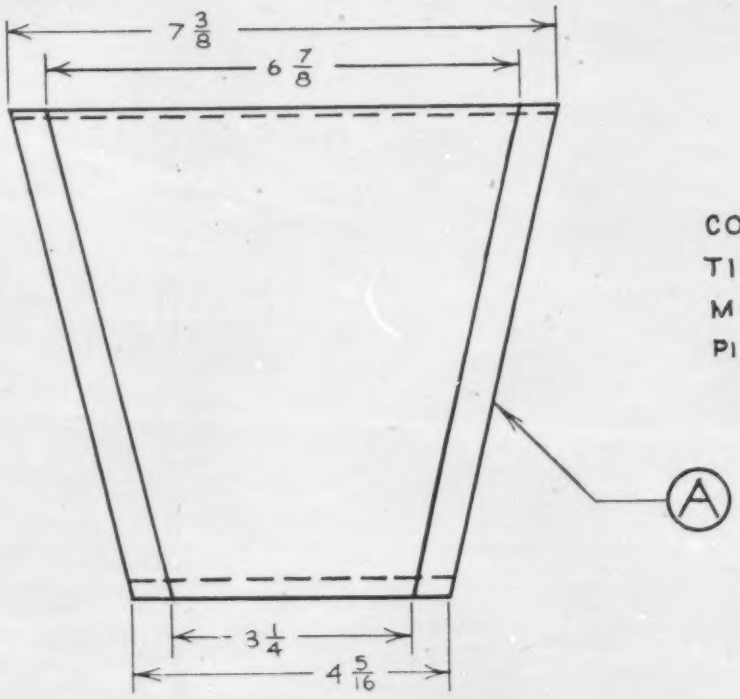


BILL OF MATERIALS

NO	NAME	MAT.	SIZE	QUAN.
A&C	SIDES	RED W.	1 X	4
B	FRONT	RED W.	1 X	1
G	BOTTOM	RED W.	1 X	1
H	ROOST	DOWEL	$\frac{3}{8}$	1
E	ROOF SEC. (RIGHT)	RED W.	1 X	5
D	ROOF SEC. (LEFT)	RED W.	1 X	5
F	ROOF FLASHING	COPPER	32 GA.	5
J	HINGE	BRASS	$1\frac{1}{2}$ X $1\frac{1}{2}$	1
K	SCREWS	BRASS	$\frac{1}{2}$" #5 F.H.	6
I	PIPE HOLDER	STEEL	1"	1
L	SCREWS	STEEL	1" #8 F.H.	4
M	FINISH NAILS	STEEL	4 D	5
N	GLUE	EXT.	—	—

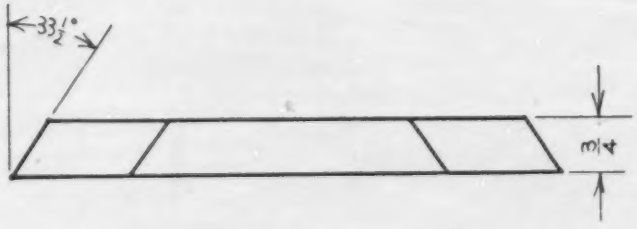
TITLE: PENTAGON BIRD HOUSE

SCALE: $\frac{1}{4}$" = 1"
SH. 1 OF 10 SHS.

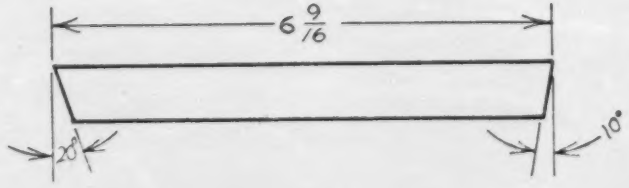


TOP

COMPOUND ANGLE SETTINGS:
TILT OF SAW - 33 1/2°
MITER GAGE - 14°
PIECES REQUIRED: FOUR



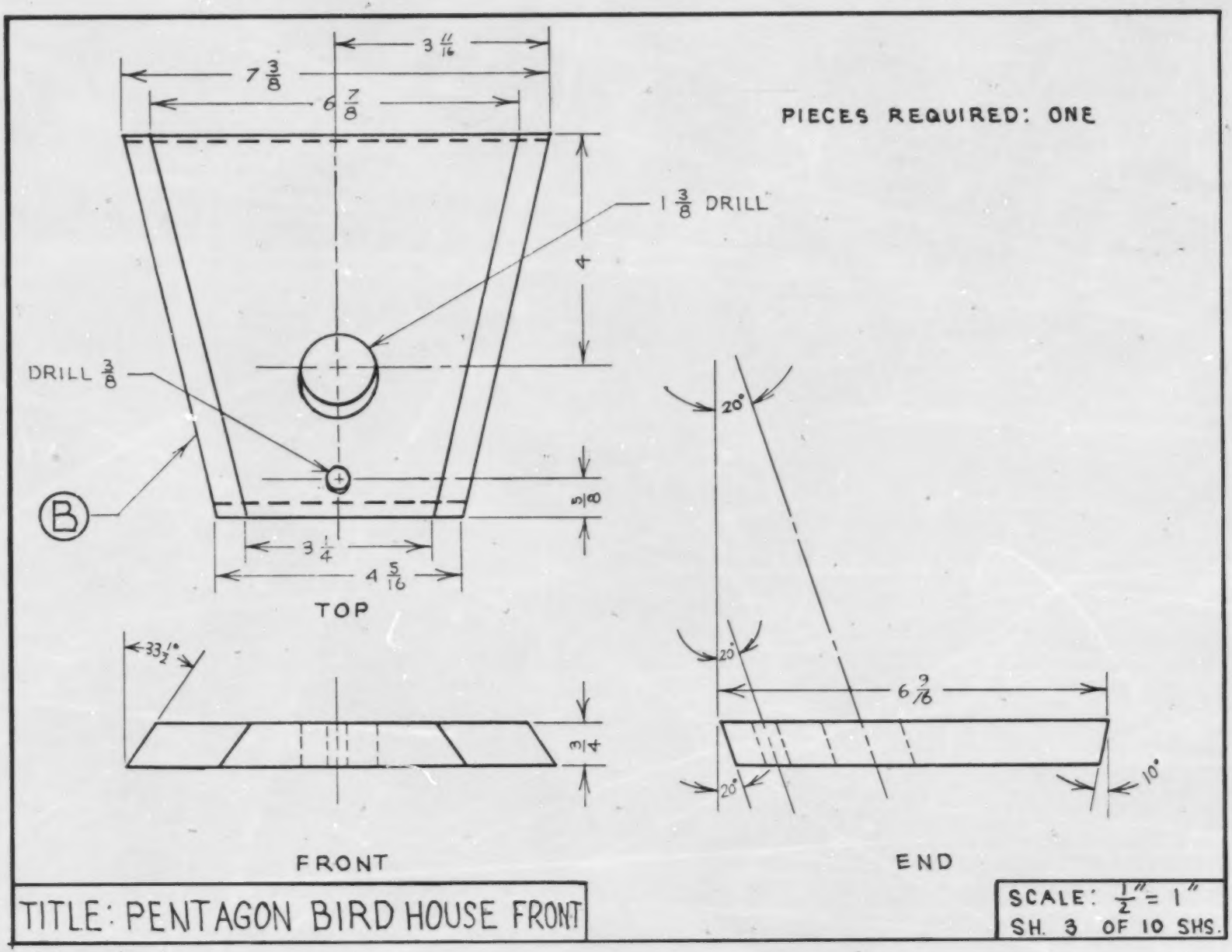
FRONT

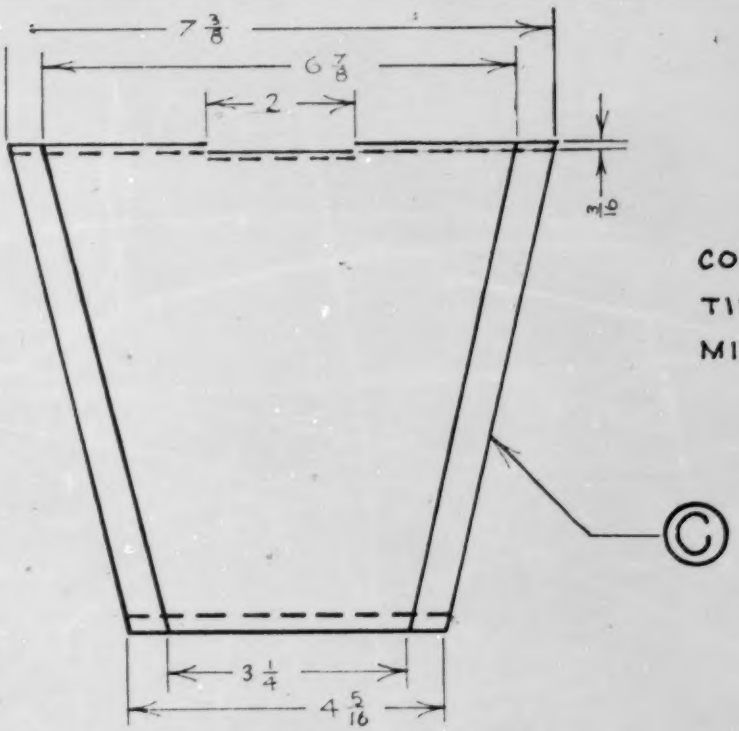


END

TITLE: PENTAGON BIRD HOUSE SIDE

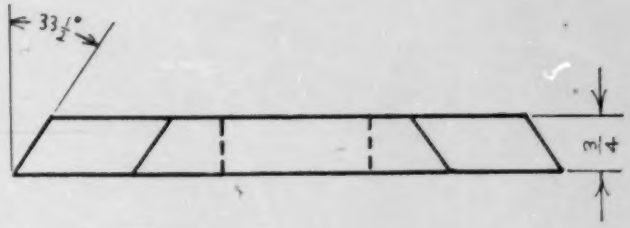
SCALE: 1/2" = 1"
SH. 2 OF 10 SHS.


PIECES REQUIRED: ONE
3 11/16
7 3/8
6 7/8
1 3/8 DRILL
4
DRILL 3/8
B
5/8
3 1/4
4 5/16
TOP
33 1/2°
3/4
FRONT
20°
20°
6 3/16
20°
10°
END
TITLE: PENTAGON BIRD HOUSE FRONT
SCALE: 1/2" = 1"
SH. 3 OF 10 SHS.

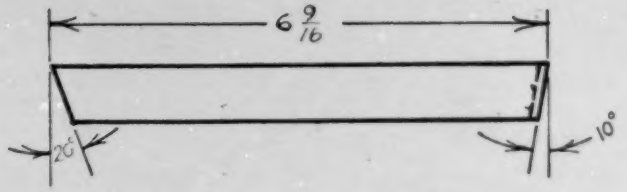


TOP

COMPOUND ANGLE SETTINGS:
TILT OF SAW – 33 1/2°
MITER GAGE - 14°



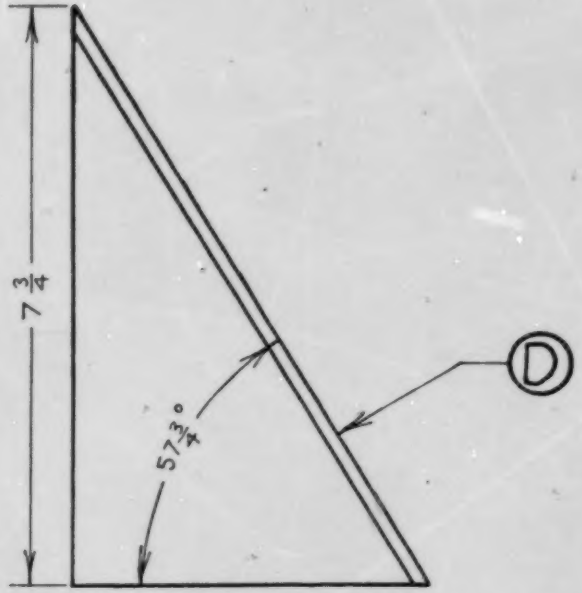
FRONT



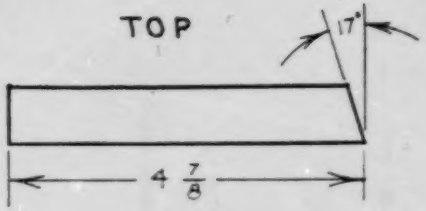
END

TITLE: PENTAGON BIRD HOUSE SIDE (HINGE)
NUMBER OF PIECES REQUIRED: ONE

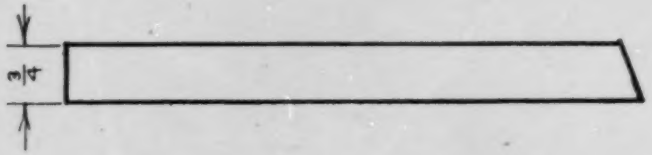
SCALE: 1/2" = 1"
SH. 4 OF 10 SHS.



COMPOUND ANGLE SETTINGS
TILT OF SAW - 17°
MITER GAGE - 57 3/4°



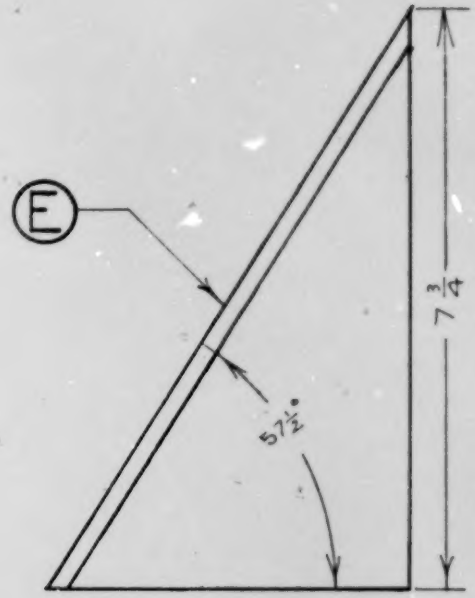
FRONT



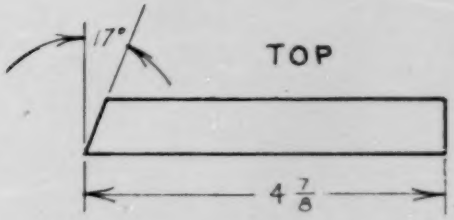
END

TITLE: PENTAGON BIRD HOUSE ROOF SEC. (LEFT)
NUMBER OF PIECES REQUIRED: FIVE

SCALE: 1/2" = 1"
SH. 5 OF 10 SHS.

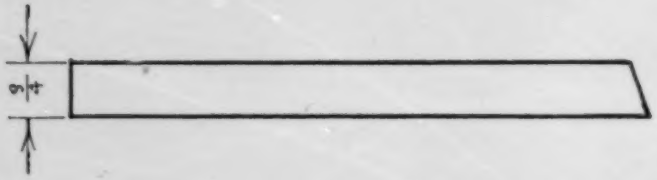


COMPOUND ANGLE SETTINGS
TILT OF SAW - 17°
MITER GAGE - 57 3/4°



TOP

FRONT



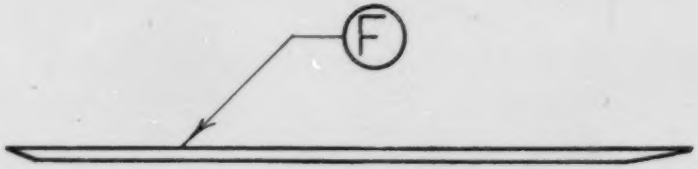
END

TITLE: PENTAGON BIRD HOUSE ROOF SEC. (RIGHT)
NUMBER OF PIECES REQUIRED: FIVE

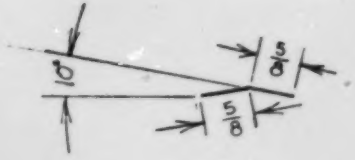
SCALE: 1/2" = 1"
SH. 6 OF 10 SHS.

100

TOP



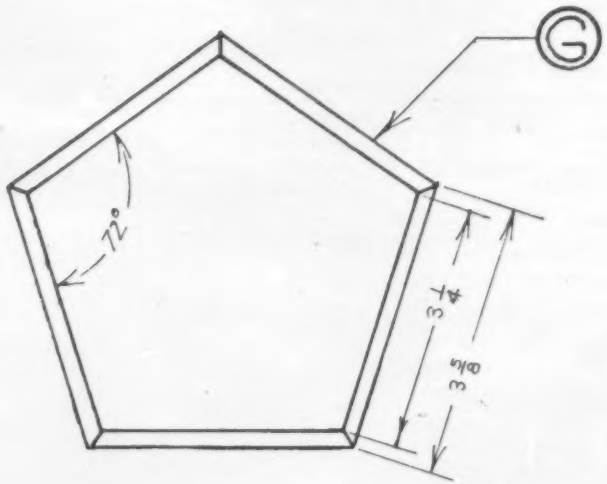
FRONT



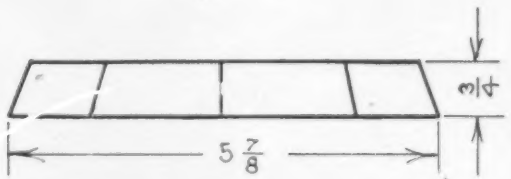
END

TITLE: PENTAGON BIRD HOUSE ROOF FLASHING
NUMBER OF PIECES REQUIRED: FIVE

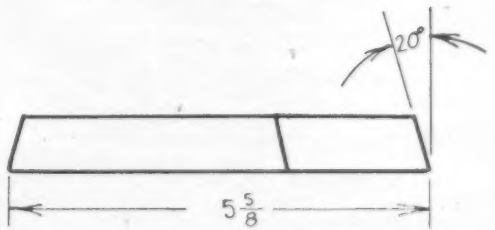
SCALE: 1/2" = 1"
SH. 8 OF 10 SHS.



TOP



FRONT



END

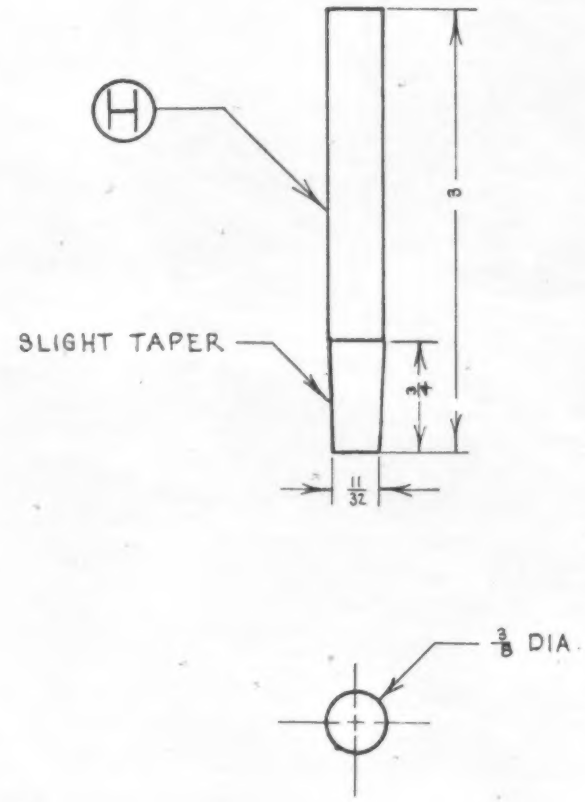
TITLE: PENTAGON BIRD HOUSE BOTTOM
NUMBER OF PIECES REQUIRED: ONE

SCALE: 1" = 1"
SH. 7 OF 10 SHS.

102

133

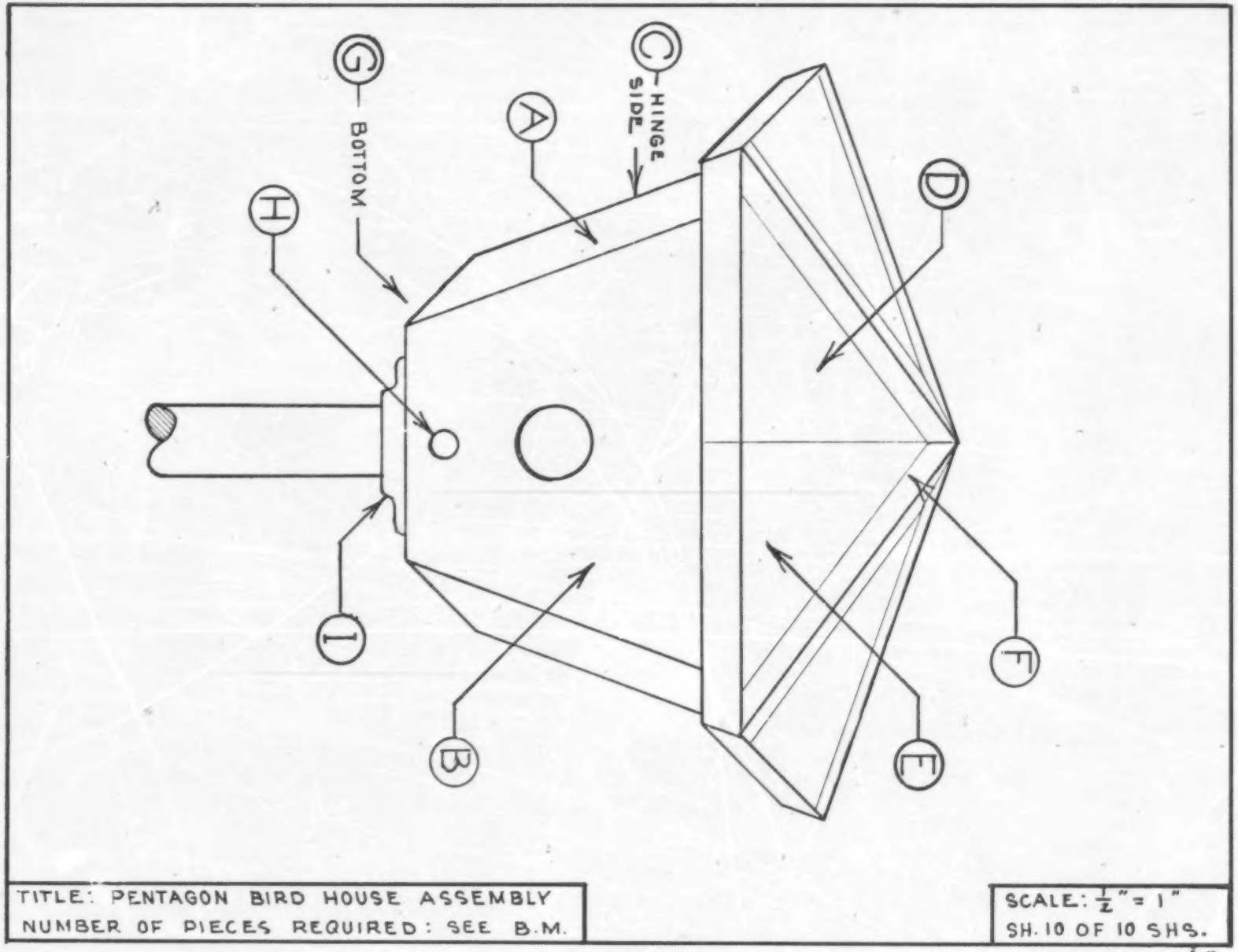
13



TITLE: PENTAGON BIRD HOUSE ROOST
NUMBER OF PIECES REQUIRED: ONE

SCALE: FULL
SH. 9 OF 10 SHS.

103



TITLE: PENTAGON BIRD HOUSE ASSEMBLY
NUMBER OF PIECES REQUIRED: SEE B.M.

SCALE: $\frac{1}{2}$" = 1"
SH. 10 OF 10 SHS.

GLOSSARY

ADVERTISING: informing potential customers about a product.

ASSEMBLY LINE: work stations, usually along a conveyor, where each worker performs a special task on the product as it moves along.

AUTOMATION: a system of manufacturing in which the processes of production are self-operating.

BID: a definite fixed price given on work or material as a complete job.

BILL OF MATERIALS: a written description of the materials necessary to produce a product.

BOARD OF DIRECTORS: a body of officials elected by the stockholders to oversee the running of a corporation.

BOTTLENECK: a slow down in the rate of production at a particular work station.

BRAINSTORMING: a free-wheeling group discussion to generate ideas.

BREAK EVEN: to take in the same amount of money as it costs to produce a product.

CAPITAL: the money and property necessary to run a business.

CONVEYOR: a device for moving objects from one operation to the next.

CORPORATION: a business owned by many people who invest their money and share in the profits of the business.

COST STATEMENT: a written account of the amount of money needed to produce an item.

CREDIT: borrowing on future hopes of production.

CRITIQUE: a careful analysis or review of an activity.

CYBERNETICS: a system of control where a machine automatically moves, regulates, and corrects itself.

DISSOLUTION: the process of terminating a corporation.

DIVISION OF LABOR: the separation of work into its elemental tasks, and each task being performed by different individuals.

DOMESTIC CORPORATION: a corporation that is operating in the state in which it was formed.

ESTIMATE: a given price that is subject to change.

EQUIPMENT: the tools and machines used in production.

FEASIBILITY STUDY: a critical examination of a product to determine whether or not it is practical to produce it.

FINANCE: obtaining, using, and controlling money.

FIXTURE: a work-supporting and work-holding device usually attached to a machine.

FLOW DIAGRAM: a drawing showing the path taken by a product during its production.

FOREIGN CORPORATION: a corporation operating in a state other than that in which it was formed.

GAUGE: a device used to determine whether or not a part is within certain limits.

"GO" GAUGE: a gauge that must slide on or into the work for the work to be acceptable.

HOUSEKEEPING: maintaining the work area and its surroundings in an orderly, neat and clean manner.

IDEATION: the process of coming up with new thoughts.

INCORPORATING: the process of forming a corporation.

INTERCHANGEABILITY: the property of a part to be randomly selected from any one of like parts and have it accurately fit the product.

INVOLUNTARY DISSOLUTION: terminating a corporation without its consent.

JIG: a work-supporting, work-holding, and tool guiding device that can be moved with the work.

JOB DESCRIPTION: a brief summary of the job, duties of the worker, and qualifications a worker must have to do the job.

LINE ORGANIZATION: a management structure in which the president has no one assisting him in running a business.

LOAN: money borrowed from people or companies.

MATERIALS: the substances that are used in the manufacture of a product.

MATERIALS HANDLING: moving, packaging and storing of objects.

MARKET RESEARCH: the process of finding out the needs and desires of the consumer.

MARKET SURVEY: a study of potential buyers to determine their views of a product or service.

MARKETING: the selling of a product.

MASS PRODUCTION: the manufacture of a product in quantity where each part of the product is assembled in a continuous manner.

MOTION STUDY: analyzing a worker's movements while performing a task.

MODEL: a three-dimensional representation of a product, usually built to scale.

"NO GO" GAUGE: a gauge that must not slide on or into the work in order for the work to be acceptable.

NUMERICAL CONTROL: a process of operating and regulating a machine by a series of programmed symbols.

ON THE JOB TRAINING (OJT): a method of instructing new employees while doing the actual work.

OPERATION SHEET: a thorough step-by-step explanation of the processes necessary to complete each part of a product.

PACKAGING: protecting and decorating products, usually with an enclosure.

PARTNERSHIP: a business owned by two or more persons.

PERSONNEL: people employed to do work.

PERT (PROGRAM EVALUATION AND REVIEW TECHNIQUE): a system of organizing, planning, and scheduling activities.

PILOT RUN: the first run of a production line to test its functioning.

PLUG GAUGE: a gauge used for internal round objects.

PREVENTIVE MAINTENANCE: a program of upkeep that anticipates failure of equipment.

PROCUREMENT: the obtaining of the necessary items for production.

PRODUCT: the item that is made by industry.

PRODUCTION: the process of creating something of value.

PROGRESS CHART: a graphic representation of daily activities.

PROGRESS REPORT: a record of work inclusive of a certain time period.

PROFIT AND LOSS STATEMENT: a written account of expenses and income to show the amount of money made or lost during a period of time.

PROPRIETORSHIP: a business owned by one person.

PROTOTYPE: the first full size finished product.

PRICING: the determination of the amount of money asked for the product.

QUALITY: the degree to which an item effectively serves its intended purpose.

QUALITY CONTROL: the process of measuring and testing products to see that established standards are being met.

QUANTITY: the amount.

QUOTATION: a statement of the current price for work or materials.

RESEARCH AND DEVELOPMENT: study and investigation to uncover new facts.

RESOLUTION OF DISSOLUTION: an official document issued by the state recognizing the termination of a corporation.

RETAILING: selling a product to a customer whose intent is to use the product.

RING GAUGE: a gauge used for external round objects.

SKETCHING: the process of drawing without the aid of instruments.

SNAP GAUGE: a tool shaped like the letter "U" which is used for checking external dimensions.

SPECIFICATIONS: a detailed description of parts including size, quality, and performance.

STAFF ORGANIZATION: a management structure in which the president has special people to assist him in running a business.

STOCKS: an investment of money into a company for an expected share of the profits.

TIME STUDY: determining the amount of time necessary to do a particular operation.

VOLUNTARY DISSOLUTION: a corporation terminating itself of its own free will.

WHOLESALING: selling a product to a customer whose intent is to resell the product as a profit to himself.

WORK STATION: a specific location at which work is performed usually equipped with necessary tools.

WORKING DRAWINGS: a set of drawings having sufficient information to make that item.